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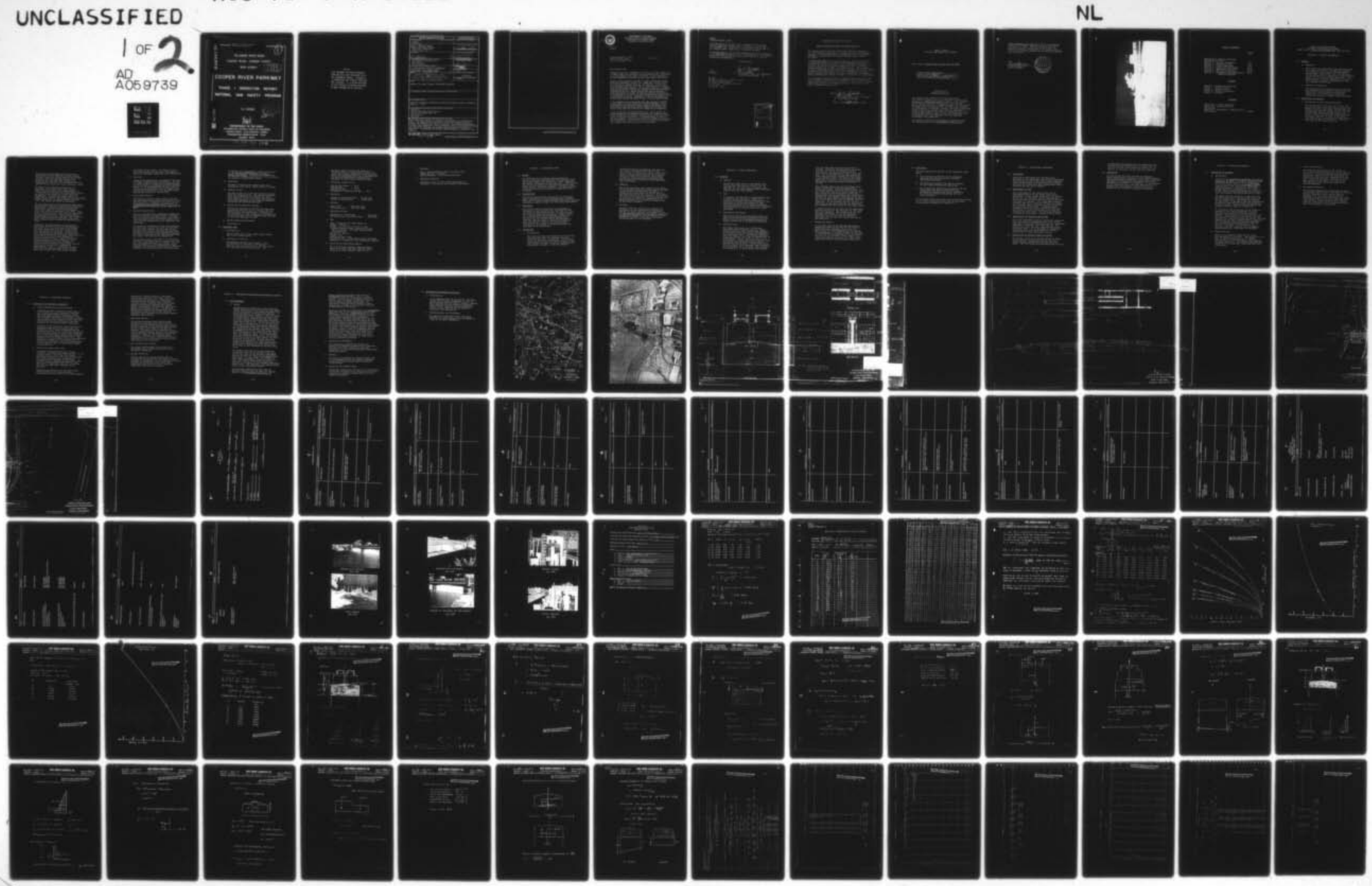

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DELAWARE RIVER BASIN

COOPER RIVER, CAMDEN COUNTY

NEW JERSEY

COOPER RIVER PARKWAY

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

NJ 00393

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106
AUGUST 1978

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Camden County, N.J.

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Cooper River Parkway Dam, N.J.
Dam Inspection
Dam Safety

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

19 SEP 1978

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Cooper River Parkway Dam in Camden County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given on the first three pages of the report.

Based on visual inspection, available records, calculations and past operational performance, Cooper River Parkway Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition. The spillway's capacity is considered inadequate since 44% of the One Half Probable Maximum Flood (1/2 PMF) would overtop the dam. However, because this dam is principally a tidal flood-control structure, the hydraulic capacity is believed to be satisfactory in view of its intended purpose and the physical aspects of the location of the dam. Overtopping of the abutments would not significantly increase the danger of loss of life or property damage.

It is recommended that within three years from the date of approval of this report, the owner review the hoisting arrangement to see if modifications could be made to permit a greater gate opening, both with regard to obtaining added release capacity and for permitting access to the lower end of the gate for inspection and maintenance.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James J. Florio of the First District. Under the provisions of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

NAPEN-D
Honorable Brendan T. Byrne

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia, 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely yours,

1 Incl
As stated

JOEL T. CALLAHAN
Lieutentant Colonel, Corps of Engineers
Acting District Engineer

Cy furn:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N. J. Dept. of Environmental Protection
P.O. Box 2809
Trenton, NJ 08625

COOPER RIVER PARKWAY DAM (NJ00393)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 14 June 1978 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The state, under agreement with the U. S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

The Cooper River Parkway Dam, initially listed as a high hazard potential structure, but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition. The spillway's capacity is considered inadequate since 44% of the One Half Probable Maximum Flood (1/2 PMF) would overtop the dam. However, because this dam is principally a tidal flood-control structure, the hydraulic capacity is believed to be satisfactory in view of its intended purpose and the physical aspects of the location of the dam. Overtopping of the abutments would not significantly increase the danger of loss of life or property damage.

It is recommended that within three years from the date of approval of this report, the owner review the hoisting arrangement to see if modifications could be made to permit a greater gate opening, both with regard to obtaining added release capacity and for permitting access to the lower end of the gate for inspection and maintenance.

APPROVED: Joel T. Callahan
JOEL T. CALLAHAN
Lieutenant Colonel, Corps of Engineers
Acting District Engineer

DATE: 19 September 1978

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Cooper River Parkway Dam NJ 00393

State Located New Jersey
County Located Camden
Coordinates Lat.3955.9 - Long.7505.0
Date of Inspection 14 June 1978

ASSESSMENT OF
GENERAL CONDITIONS

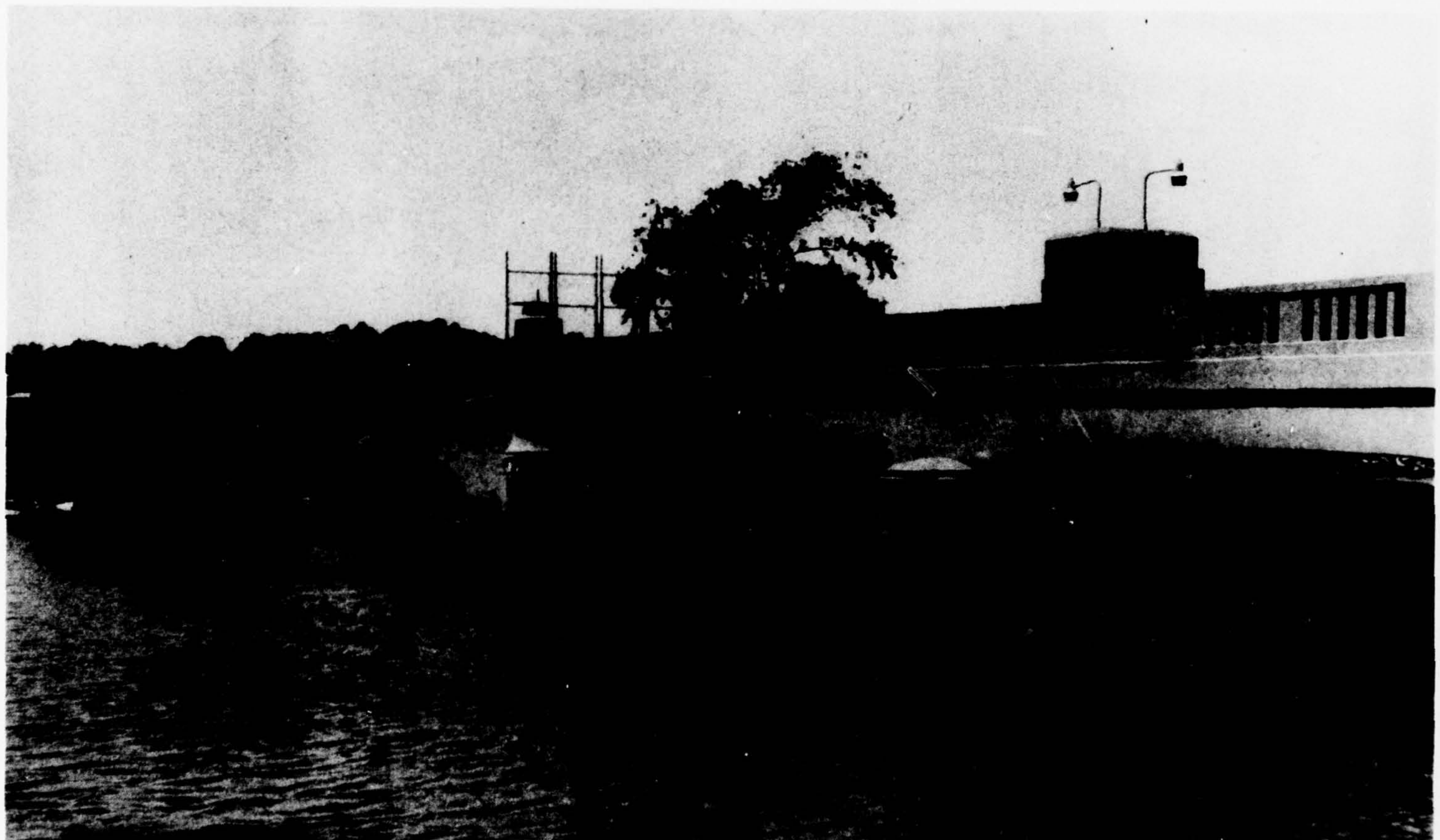
The Cooper River Parkway Dam is assessed to be structurally adequate and it is downgraded from a high hazard to a significant hazard category. Overtopping of the abutments would not significantly increase the danger of loss of life or property damage. No detrimental findings were uncovered to merit further study, either of a structural or hydraulic nature. The only recommended further action is to direct the owner to undertake a study in the future to ascertain if modifications to the hoist system could be made to raise the tidal gates to a higher position for increased flow and improved maintenance and inspection.

The spillway capacity is inadequate and does not meet the requirements of the Recommended Guidelines for

Safety Inspection of Dams being able to accommodate only 43% of the SDF. However, because this dam is principally a tidal flood-control structure, its hydraulic capacity is believed to be satisfactory in view of its intended purpose and the physical aspects of its location.

F. Keith Jolls P.E.
Project Manager

STATE OF KENTUCKY
F. KEITH
JOLLS
5432
REGISTERED
PROFESSIONAL ENGINEER



JULY 1978

OVERVIEW OF COOPER RIVER PARKWAY DAM

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
NAME OF DAM COOPER RIVER PARKWAY DAM FED# NJ 00393

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Division of Water Resources. The State,in turn, is under agreement with the U.S. Army Engineer District, Philadelphia to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Cooper River Parkway Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

The dam structure consists of a 45 foot wide by 156 foot long by 18 foot deep concrete base topped by three 8 foot wide, 17 feet high by 38 foot long concrete piers; with two 45 foot long bridges spanning between piers. Two 45 foot long by 15 foot high fixed wheel tide gates are installed in slots in the piers, with gate sills at elevation -6.0 feet (M.S.L.) and with the tops of the gates at elevation +9.0 feet in the closed position.

The base was constructed by first driving a steel sheet piling cofferdam 45 feet wide by 156 feet long, with piling penetrating to about elevation -50 into sand and gravel. The inside of the cell was then excavated to approximately elevation -24 and backfilled with concrete to the gate sill level elevation (-6.0).

The deck of the operating bridges is at elevation +15.0 feet and is constructed of four concrete encased steel arch trusses. A 5 foot wide slot through the bridge deck permits the gates to be lifted to a level above the bridge deck. Because the bridge soffit is lower than the top of the gates, the superstructure hinders flow over the gates (above elevation 7.5). The soffit is curved in elevation.

The two vertical-lift tide gates are fabricated of structural steel with upstream and downstream skinplates. Installed within each gate are nine 3 feet wide by 2 feet high sluiceways, with their sills at elevation +1.75 feet. Flap gates, 3 feet wide by 2 feet high are installed on the downstream side. These gates operate automatically by gravity and open when reservoir water level exceeds the tailwater, and close when tidewater level exceeds the upstream lake level.

Initially, the tide gates were raised and lowered by screwlift hoists, which permitted the gates to be raised to their full height. The screw stems were attached to davit arms near the bottom of the gates. Difficulties were experienced in operating the gates with the hoisting mechanism originally installed, so in 1975, the screw hoists were replaced by hydraulic piston hoists. They are operated either separately or simultaneously. The hydraulic piston hoists are attached to lifting frames anchored to the bridge, and the gates can be raised only a maximum of approximately 4 feet. A crosswalk was also installed over the gate slot on the bridge deck, which limits the lift height to which

the gates can be raised. In order to raise the gate entirely out of water, the hydraulic hoist and crosswalk would have to be dismantled.

b. Location

Cooper River Parkway Dam is located in the City of Camden, Camden County, New Jersey. The dam is built across the Cooper River approximately 2.0 miles from its confluence with the Delaware River. It is approximately 500 feet south of the Kaighn Avenue bridge over the Cooper River and 500 yards southwest of the Airport Circle Interchange (Routes 30, 38 and 130).

c. Size Classification

The height of the dam tidal gates is 15 feet and the conservation storage is estimated to be 2900 acre feet. Therefore, the dam is in the intermediate size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification

The City of Camden lies immediately downstream on both sides of the Cooper River. Although this is a densely populated urban area, much of the development below the normal maximum high tide from the Delaware River is commercial and industrial.

The danger of inundation of the lands adjacent to this lower reach of the river is much more critical with regards to high tides in the Delaware River rather than from upstream flow. The dam was originally constructed principally for tidal protection of the upstream parklands, boat basin, and surrounding communities.

The economic loss is believed to be extremely minimal in the downstream area should this dam fail from upstream flooding. However, due to close proximity of urban development; major highways, and extensive industrial and commercial property, the hazard potential classification

is deemed to be significant, within the context of the Recommended Guidelines for Safety Inspection of Dams. A failure or misoperation of this dam actually presents only a minor concern in relation to downstream hazard.

e. Ownership

The dam is owned by the Camden County Park Commission, Park Drive, Cherry Hill, N.J. 08054

f. Purpose of Dam

The dam is used for flood and tidewater control from the Delaware River. The dam and tidewater gates were installed to mitigate the daily tide variation (4.5'±) and lessen the influence of maximum backwater (El.9±) from the Delaware River upon the upstream parklands.

g. Design and Construction History

The dam was designed in 1938 by the consulting engineering firm of Justin & Courtney for the Camden County Park Commission. Construction was completed in 1940. Mechanical modifications to the tidal gate lifting supports were designed in 1975 and installed in 1976.

h. Normal Operating Procedures

See Section 4

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of the Cooper River Parkway Dam is 37.0 square miles.

b. Discharge at Dam Site

No discharge records are available. From discussions with the owner, the maximum observed high water occurred in 1971 and topped the tidal gates by about one foot. The

spillway capacity within the gates in a raised position is approximately 8500 c.f.s. (with their present restricted lift capacity). Hence for downstream flow, it is believed that the dam was hydraulically designed for a discharge in this range of maximum flows.

c. Elevation (above M.S.L.)

Top of dam (gates) - +9.0
Maximum pool - +9.0
Recreation pool - +1.75
Streambed at centerline of dam - -6.0

d. Reservoir

Length of recreation pool - 14,500 feet
Length of maximum pool - 20,000 feet

e. Storage

Top of dam - 2900 acre feet
Recreation pool - 1150 acre feet

f. Reservoir Surface

Maximum pool (top of dam) - 300 acres
Recreation pool (spillway crest) - 190 acres

g. Dam

Type - vertical lift tidal gates (2)
Length - 156 feet
Height - 15 feet (sill to top of gate)
Freeboard between normal reservoir and the top of the dam - 7.25 feet (varies with gate position)
Top width - 28 feet
Zoning - N/A
Impervious core - N/A
Cut-off curtain - steel sheet piling cofferdam
Embankment - composition and compactness unknown

h. Diversion and Regulating Tunnel

48" Ø at the west abutment that equalizes water level with river and cemetery lagoon adjacent to river channel. (See 3.1.d.)

i. Spillway

Type - steel hydraulic gates (vertical lift)
Length of weir - 90 feet
Crest elevation - +9.0 (Closed position)

j. Regulating Outlets

Eighteen 2 feet x 3 feet tidal flap gates at elevation +1.75 (built into vertical lift gates)

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

An incomplete set of design plans prepared by Justin & Courtney dated May 1938 were obtained from the Camden County Park Commission. These indicated the overall dimensions of the structure. Additionally, prints of the mechanical modifications made to the tidal gates in 1975 were reviewed. No specifications or any of the original hydraulic computations were available.

2.2 CONSTRUCTION

The dam was purportedly constructed to the design plans although no as-built drawings were available. There are no apparent modifications, alterations or major maintenance repairs except the 1975 hoist replacement.

2.3 OPERATION

The contract plans allowed for an adjustment in thickness of the concrete base slab from 16 feet to 8 feet at each sheeting line (in case the sand and gravel stratum was located at a higher level). It is unknown what exact thickness of base slab was cast but the appended check computations indicate that the minimum thickness specified is more than adequate from a stability standpoint (see Section 6). There is no evidence that differential settlement or lateral shifting has occurred in the foundations.

2.4 EVALUATION

a. Availability

The tide gate sill (at elevation -6.0) is such that when the gates are closed, the lower 8 feet of the gate is submerged. The original design permitted the gate to be hoisted to its full height, so that it could be inspected and maintained as needed. With the recently

installed hoisting arrangement, the gate can be lifted a maximum of only about 4 feet, and to raise it completely out of water would require dismantling the hoists and crossover walks and lifting the gates by other means. It was not ascertained what procedures have been devised for raising the gates completely out of the water.

b. Adequacy

The field inspection and review of the summary of the design calculations presented on the 1938 contract plans revealed that the dam is structurally sound except for minor spalling and deterioration of the concrete. It is therefore felt that sufficient valid engineering data is available to render an assessment of the design although only a partially complete set of plans were available.

c. Validity

Original stability studies and analysis are acceptable in that conventional techniques, similar to those outlined in Paragraph 4.4 of the Recommended Guidelines for Safety Inspection of Dams were employed. In the opinion of the inspecting engineer, additional structural investigations are not required.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The visual inspections of the Cooper River Parkway Dam took place on June 14, 21, 28, and July 19. Mr. Neville C. Courtney, the designer of the dam accompanied the inspection team on the July 19th review.

b. Dam

In general, the dam and its appurtenances are in satisfactory condition. There is no evidence of seepage (due most probably to the fact that there was practically no head differential during the inspection period). Only the condition of the tidal gates themselves is unknown as the lower sections are always submerged.

c. Appurtenant Structures

Some concrete spalling and deterioration was observed at the concrete abutments and wing-walls. The railing, equipment housings and superstructure are in acceptable condition.

d. Reservoir Area

The Cooper River Lake is a 3 mile long artificial lake following the river course upstream from the dam, and has been enlarged to the left of the main channel by dredging a low lying marsh area. The minimum reservoir level of operation 1.75 feet is established to correspond to the sill level of the 3' x 2' sluice gates. Actual lake levels are dictated by inflows from upstream and by outflows through the sluice gates. During flood flows from the Cooper River upstream, when tidewater in the Delaware is at a higher stage or when the Delaware is in flood stage, all inflows

into the lake must be captured and held in storage. Surcharge storage between elevation 1.75 and the top of the tidewater gate elevation 9.0 is estimated at about 1750 acre feet. If no releases can be made through the tide gates and sluices because of high stage in the Delaware River, all inflows into Cooper River Lake in excess of 1750 acre feet would overtop the gates and abutment approaches to the dam.

Just upstream and to the left of Cooper River Lake a large marsh area was dredged and a lagoon was formed, separated from the main lake by a dike whose top is at about elevation +5.5. This lagoon is drained separately from the Cooper River lake by the drain line constructed through the left abutment approach to the dam. The size of this drain line is thought to be 48" and it is unknown how flow through the line is regulated. It is presumed that the control is some type of flap gate, similar to those which are installed on the sluices of the tidal gates.

A roadway parallels the river on the right side, passing the axis of the dam about 75 feet from the right abutment. The ground level of this abutment and roadway is at approximately elevation +9.0, so it would be inundated when water in the lake area neared the top of the tide gates.

e. Downstream Channel

On the left side of the dam and immediately downstream exists an area which was initially marshland below tidewater level, but has been filled in from dredgings from the lagoon formed upstream. The left abutment at the dam is indicated on the drawings to be at elevation +12± but it is not known to what extent this level was graded or if there is a lower saddle across the original marsh farther downstream.

3.2 EVALUATION

The main subjects of concern to the inspection team were:

a. The structural condition of the cofferdam sheeting with special concern regarding undermining and scour.

b. The potential hazard of the dam in relation to the bridges immediately downstream.

c. The operational aspects and maintenance of the tidal gates and the fact that they are permanently submerged and cannot completely be inspected without dismantling the new hoist equipment.

All of these items were found to be either satisfactory or of a minor hazard potential and the resulting conclusions are summarized in Section 7.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operational procedures were not physically observed by the inspection team but were explained by personnel of the Camden County Park Commission. There are presently no formal procedures except for periodic inspections after storms when debris blocking the sluices is removed.

4.2 MAINTENANCE OF DAM

The maintenance of the Cooper River dam is the responsibility of the Camden County Park Commission. Under normal conditions, the sluices built into the tidegates operate automatically by gravity and no day-to-day operation of the main tide gate is required. It is only when greater releases than can be obtained through the sluices are necessary that an operator need be available to raise the larger gates. A demonstration conducted during the field inspection indicated that there is little difficulty in raising and lowering the tide gates. The hoisting equipment is presently being kept in proper working order.

4.3 MAINTENANCE OF OPERATING FACILITIES

Since the redesigned hoisting system was installed, the tide gates have apparently not been raised more than 4 feet; the lower portions thus remaining submerged. Therefore, the lower sections and bottom seals have not been inspected during the last four years. It is not known if inspection procedures have been instituted for periodic examination of these submerged portions.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

At present, there is no warning system in effect. Park personnel continuously monitor the area during storms, periods of high tide and heavy flows. The Park Commission presently does not have

a formalized established plan for contacting civil defense and other authorities but always have an operator on-site during storms or high water who remains in telephone contact with his superiors.

4.5 EVALUATION

In view of the fact that the dam is primarily a tidal flood-control structure, little damage (except the inconvenience of flooding a boat basin immediately upstream) is encountered; the present operational procedures are deemed to be adequate. In the opinion of the inspection team, the Park Commission has an experienced, well-managed staff which is fully capable of the execution of proper maintenance.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

Utilizing the Recommended Guidelines for Safety Inspection of Dams, it has been determined that the Cooper River Parkway Dam is intermediate in size and falls into the significant hazard category due to the presence of downstream urban development. Accordingly, the spillway design flood was determined to be 1/2 PMF to PMF and the inflow hydrograph was calculated from the probable maximum precipitation (PMP).

Discharge from the reservoir is controlled by the two hydraulically operated tide gates and the 18 sluice gates. The discharge capacity of these gates is dependent upon the differential between the upstream lake level and downstream tailwater level. Under optimum conditions the maximum discharge capacity is 8500 cfs.

In accordance with directives of the Corps of Engineers, the inflow hydrograph and flood routing were calculated utilizing a HEC-1 program. Peak inflow to the reservoir for the PMF and 1/2 PMF was 44,570 cfs and 22,290 cfs respectively, indicating that the optimum discharge capacity of the dam is significantly inadequate. The 1/2 PMF was routed through the reservoir and the discharge decreased from 22,290 cfs to 19,570 cfs (SDF). On this basis, the spillway discharge capacity will accommodate approximately 43% of the SDF (1/2 the PMF).

b. Experience Data

There is no recorded stream flow or tidal data available at this site. The nearest U.S.G.S. gage on the Delaware River is at Palmyra, too far away to be useful here in ascertaining a maximum high tide. The highest tide observed occurred in 1971 and was a foot plus above the tidal gates.

c. Visual Observations

The tidegates and sluiceways all appear to be in satisfactory working order at the time of inspection. The Park Commission gate operator raised and lowered each of the tide gates to demonstrate that they were mechanically sound and in good working order. However, only one gate is able to be raised at a time due to the capacity of the motor which drives the lifting mechanism.

d. Overtopping Potential

The spillway capacity is insufficient to pass the spillway design flood. The capacity would be further reduced by tidal effects from the Delaware River by raising the tailwater. Therefore, in most flood conditions, the water level would rise both upstream and downstream from the dam. The spillway in this instance would be ineffective and overtopping, although not critical, would be inevitable.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations and Data Review

Although the dam is almost 40 years old, it is in remarkably good structural condition. The reinforced concrete abutments, center pier and superstructure have suffered very little damage and exhibit only minor cracking. The columns at each abutment corner show some surface spalling and cavitation, due most probably to the brackish water conditions.

Portions of the structural steel framing and guideways supporting the sluice gates are rusted and are in need of sandblasting and painting but most of the structural system and metal railing around the sluice gate chimneys are in excellent shape, having been repainted during the recent rehabilitation work. The vertical lift gates appear to be in satisfactory condition, insofar as the sections that are visible are concerned. The flap gates appear to be sound but some were kept from closing by small debris.

b. Design and Construction Data

A summary of applied forces for various stability conditions were shown, in part, on the original plans. From this, the design procedures employed in 1938 were reviewed and the overturning stability rechecked as contained in the appended calculations. The original design assumptions appear to have been quite conservative and it is felt that the need for additional analyses is not required.

Regarding the stability of the steel sheet piling cofferdam, the area generally surrounding the dam consists of unconsolidated,

stratified alluvial deposits. The upper stratum soil material is a sand, silty and clayey sand and sandy silt. Some gravel is intermixed with the major soil fractions and this gravel, together with coarser sand, becomes increasingly abundant with depth. Marine clay deposits may underlie the sand at depths greater than 30 feet. The depth to bedrock is estimated at greater than 100 feet. The sheeting adds little to the vertical stability but safeguards the structure against potential scour action.

c. Operating Records

The dam has performed satisfactory under conditions of extreme high tide (1971,for example) but such storms provide little basis for an evaluation of structural safety because in most cases, both sides of the dam are flooded. The most critical condition occurs with a maximum hydraulic head on one side which creates buoyancy and the greatest overturning potential. However, the original design assumptions are of such a conservative nature that even if this should occur, the stability conditions are not critical.

d. Post Construction Changes

The recent modifications to the hoisting mechanism have no appreciable effect on the structural stability.

e. Seismic Stability

Because the dam is in the Seismic Zone 1, the potential vulnerability to seismic dynamic loadings is negligible, in that the applied loads produced by earthquake forces would have negligible effects on the static stability conditions and internal stresses.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety

Summarizing the hydraulics of the study dam, Cooper River Lake is an artificial pond formed by the intallation of the study dam which was built principally to protect the adjacent parklands from tidal flooding. The lake level is controlled by flap gates installed in the two tidal gates; opening when the lake level is above tidewater and closing when tidewater rises above lake level. The sills of the flap gates are at normal pool +1.75, and the lake fluctuates daily above this level, depending on the upstream inflow and the tide elevation. For upstream storm inflows, sluiceway flow can be augmented by raising the main tidal gates, again depending on the relationship of lake level to tidewater level. It is conceivable that when upstream floods occur, the Delaware River would also be at flood stage, and that releasing inflow volume through the gates would not be possible. In that event, all inflows into Cooper River Lake would need be stored and a flooding of Cooper River Park to as high as the abutments of the dam could occur.

The Cooper River Dam can safely withstand a reservoir head up to the top of the gates and to the level of the abutment approaches without failure but would be overtopped above that level. In this event, the backwater level would presumably also be at about the same level and no flood surge downstream owing to a breaching of the abutment approaches would occur. Any subsequent overtopping would create little additional hazard.

The attached computations show that the spillway capacity does not meet the requirements of the <u>Recommended Guidelines for</u>

Safety Inspection of Dams, being able to accommodate only 43% of the SDF (1/2 PMF). However, failure from overtopping would not significantly increase the hazard of loss of life or property damage downstream. No detrimental findings were revealed in this inspection to render a questionable judgement of the hydraulic conditions.

Although, the dam is classified as an intermediate size structure in the significant hazard risk category, a 100-year frequency flood (in lieu of 1/2 PMF) was additionally examined to more realistically quantify the overtopping possibility. Surcharge storage above the dam was estimated at about 3000 acre-feet and the 100-year frequency event was estimated to have an 27-hour flood volume of about 4500 acre-feet. If during this flood event an average differential of about 1 foot was available between lake and tailwater levels, (with the tidegates opened) about 2700 acre-feet could be released in a 12-hour period. Thus, the lake level would rise only to about elevation +6.0 in this instance which would present no undue hazard to the surrounding environs.

b. Adequacy of Information

The information gathered for Phase I is deemed to be adequate regarding safe operation and the structural stability of the dam, especially in light of the hydraulic conclusions contained herein.

c. Urgency

No urgency is attached to further studies and it is recommended that the remedial measures enumerated below be taken under advisement in the future.

d. Necessity for Further Study

Additional inspections are felt to be unnecessary as the dam is deemed to be adequate and does not constitute a hazard to human life or to be a danger to property.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

a. Alternatives

It is suggested that in the future, the owner review the hoisting arrangement to see if modifications could be made to permit a greater gate opening,both with regard to obtaining added release capacity and for permitting access to the lower end of the gate for inspection and maintenance.

b. O&M Maintenance and Procedures

No additional procedures other than those currently in effect appear to be warranted in light of the above assessment.

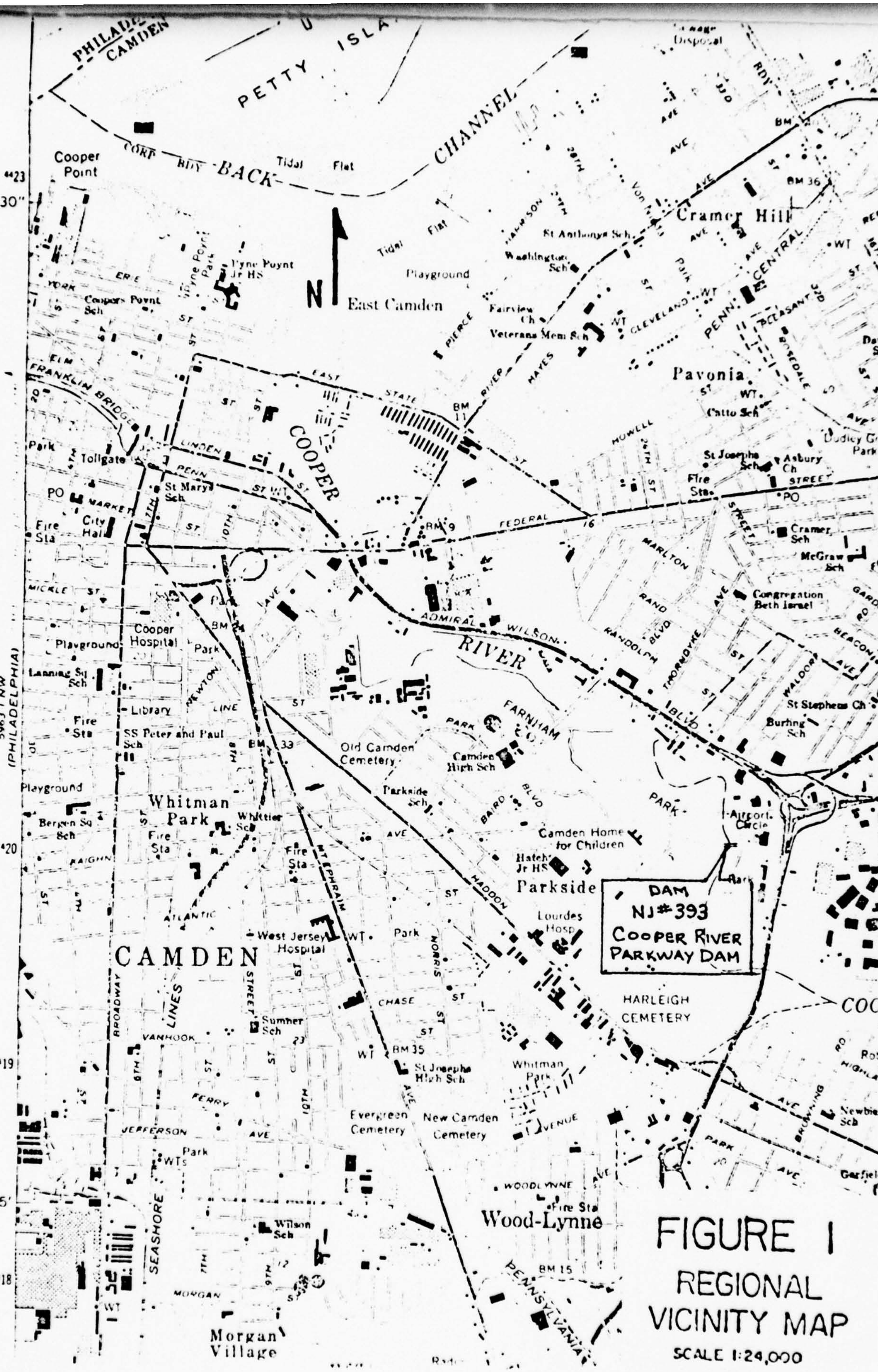
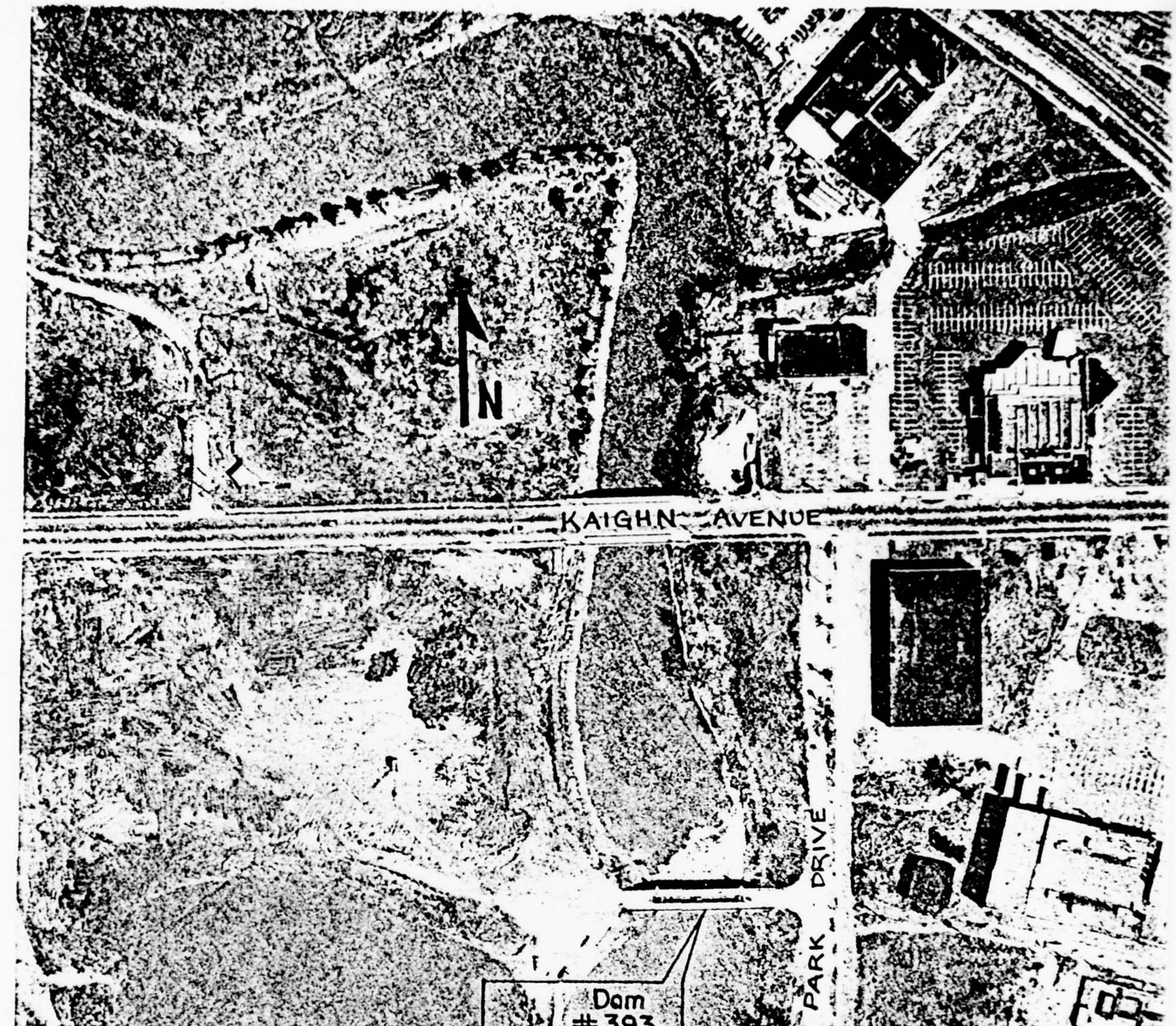
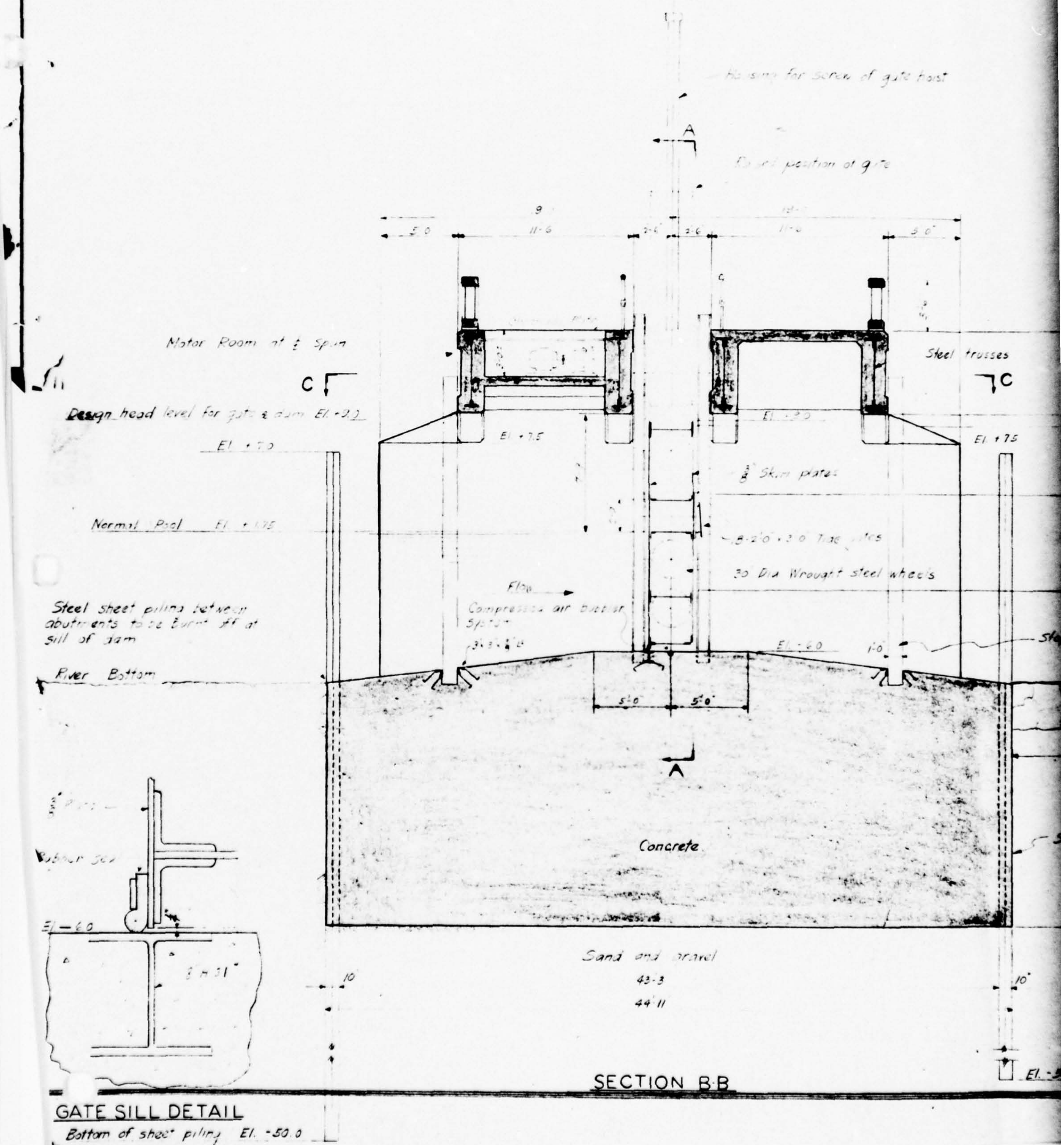


FIGURE 1
REGIONAL
VICINITY MAP
SCALE 1:24,000

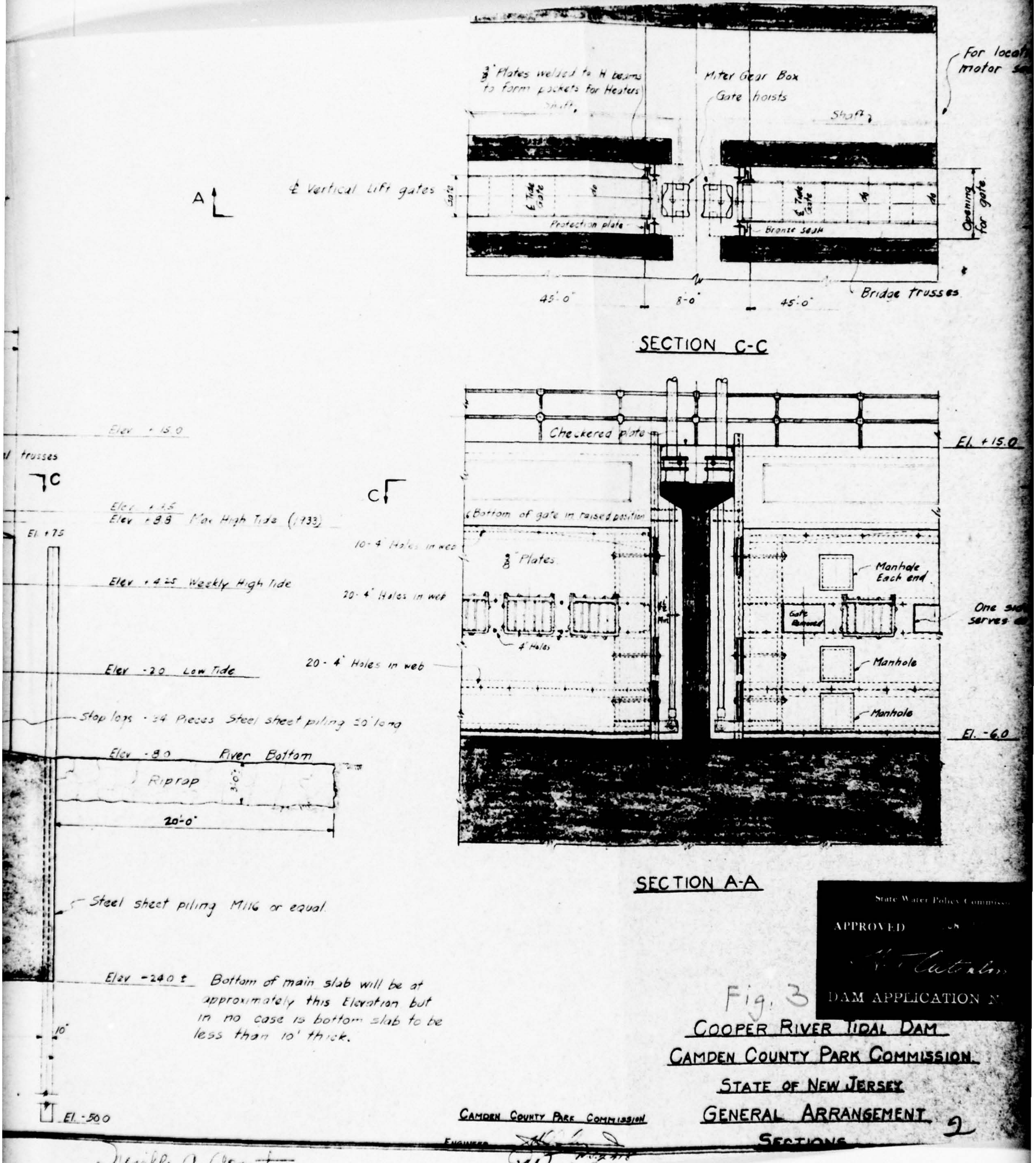

N
KAIGHN AVENUE
Dam
#393
COOPER RIVER
PARKWAY DAM
NORTH PARK DRIVE
FIGURE 2



SECTION B-B

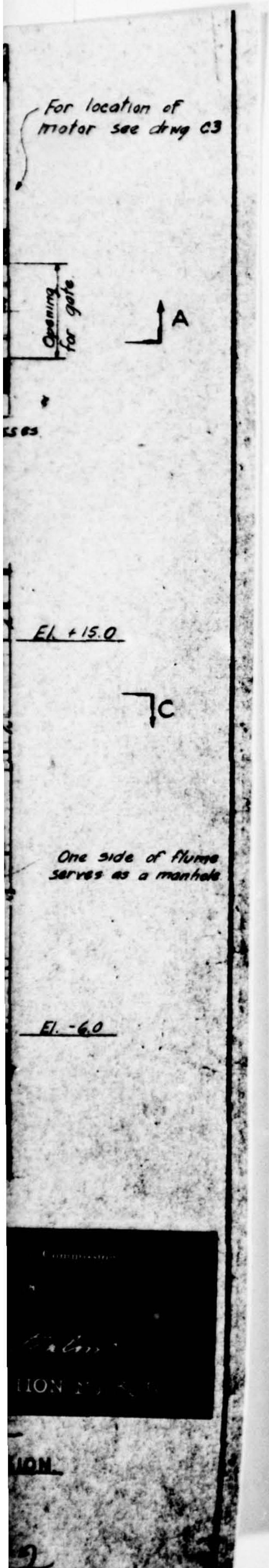
GATE SILL DETAIL

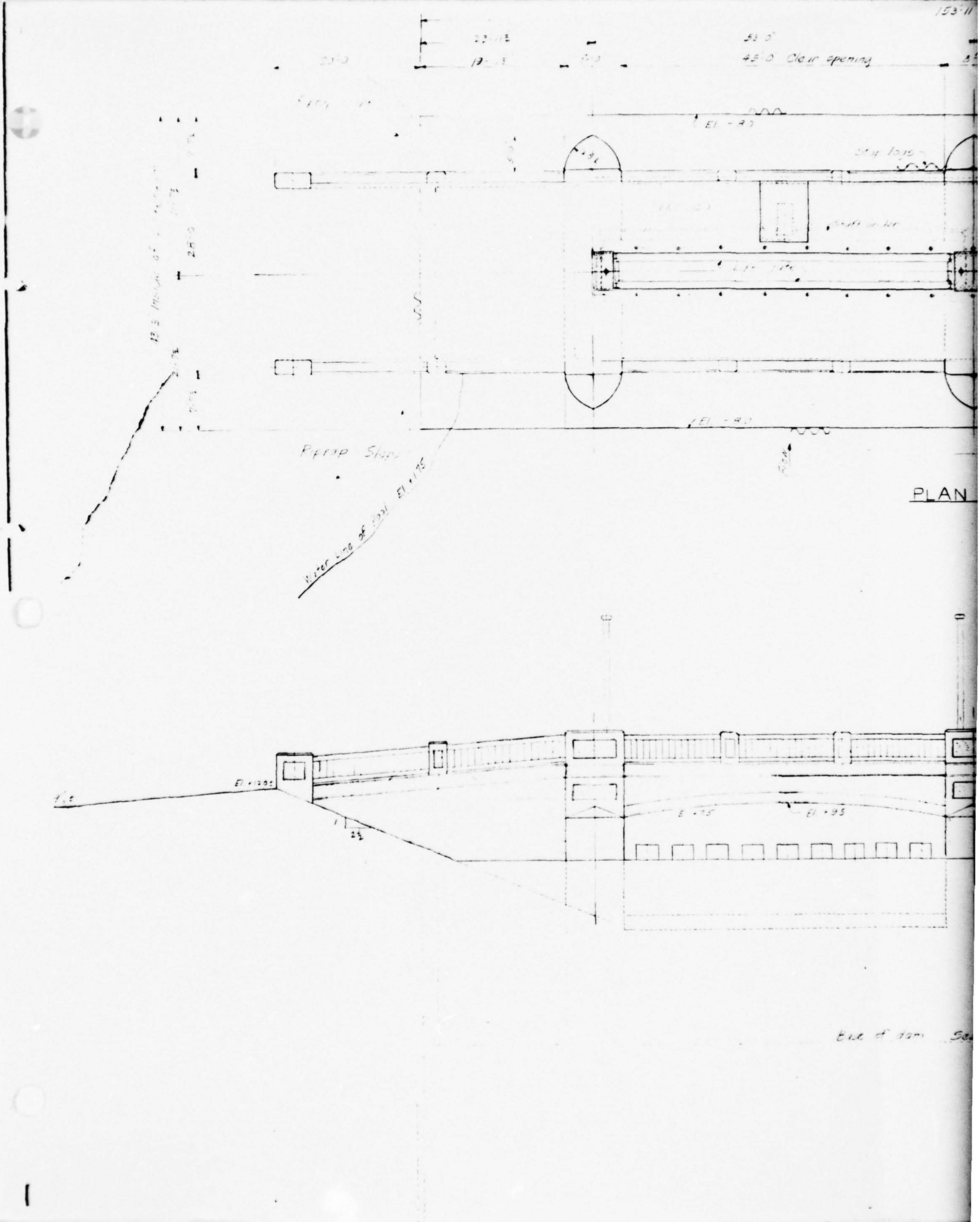
Bottom of sheet piling El. -50.0



3/8" Plates welded to H beams to form pockets for Heaters
Shaft
Miter Gear Box
Gate hoists
Shaft
For locat
motor s
℄ Vertical Lift gates
℄ Tide Gate
Protection plate
Bronze seal
Opening for gate
Bridge trusses
45'-0"
8'-0"
45'-0"
SECTION C-C
A
C
Elev +15.0
trusses
Elev +8.8 Max High Tide (1933)
El. +7.5
Elev +4.25 Weekly High tide
Elev -2.0 Low Tide
Stop logs - 34 Pieces Steel sheet piling 20' long
Elev -8.0 River Bottom
Riprap
3.0'
20'-0"
Steel sheet piling M116 or equal
Elev -24.0 ± Bottom of main slab will be at approximately this Elevation but in no case is bottom slab to be less than 10' thick.
10'
El. -50.0
Checkered plate
El. +15.0
Bottom of gate in raised position
10-4" Holes in web
3/8" Plates
20-4" Holes in web
4" Holes
Manhole Each end
Gate Removed
One side serves
20-4" Holes in web
Manhole
Manhole
El. -6.0
SECTION A-A
State Water Policy Commission
APPROVED
DAM APPLICATION N
COOPER RIVER TIDAL DAM
CAMDEN COUNTY PARK COMMISSION
STATE OF NEW JERSEY
GENERAL ARRANGEMENT
SECTIONS
2
CAMDEN COUNTY PARK COMMISSION
Neville C. Courtney
STRUCTURAL ENGINEER

Fig. 3


For location of motor see drwg C3
Opening for gate
A
El. +15.0
C
One side of flume serves as a manhole
El. -6.0



153'-11
53'-0"
45'-0" Clear opening
El. +90
Stop logs
Riprap Slope
Water line of pool El. +117.5
PLAN
El. +120.0
El. +75
El. +93
Base of dam

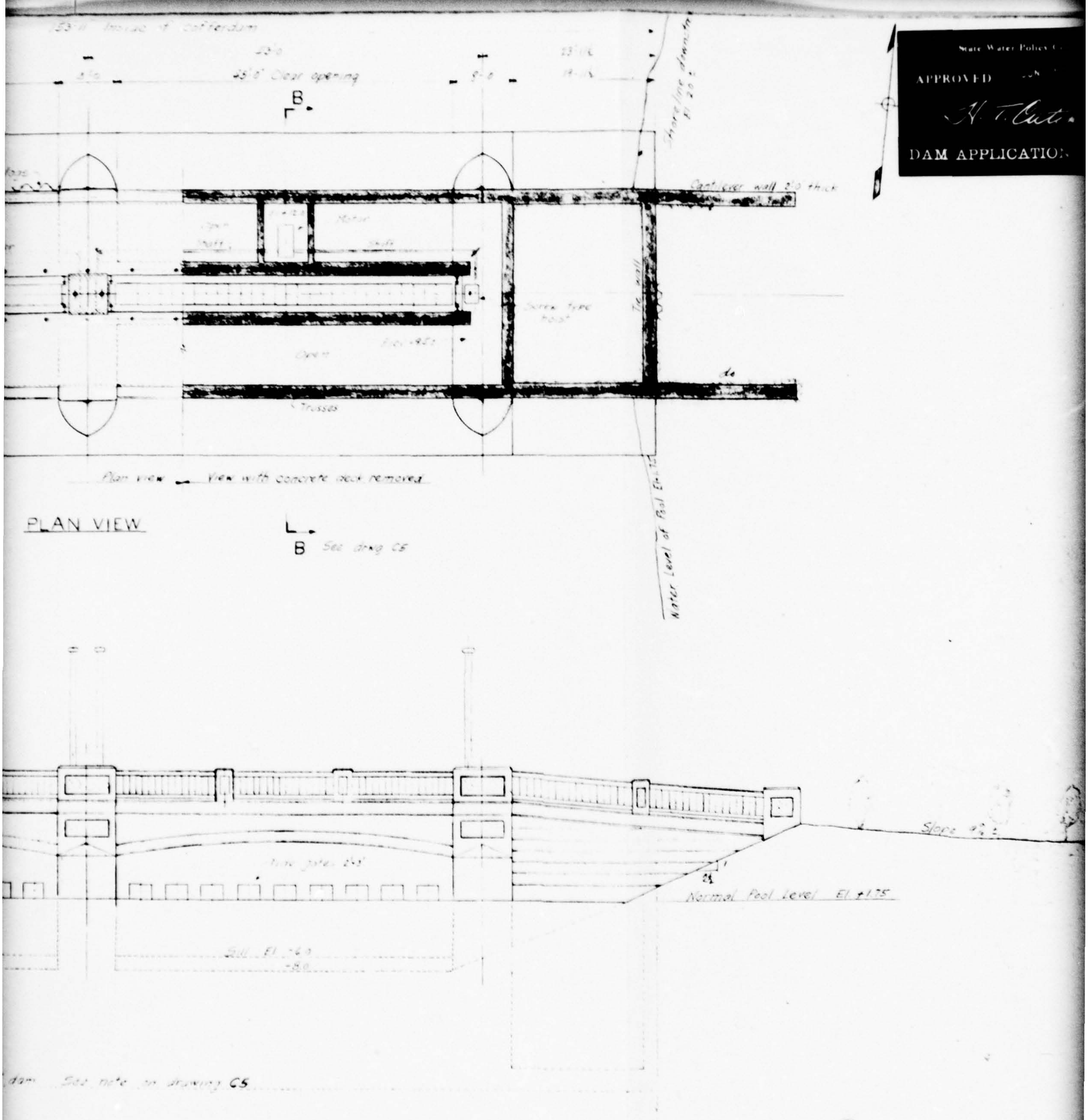


Fig 4

COOPER RIVER TIDAL DAM

CAMDEN COUNTY PARK COMMISSION

STATE OF NEW JERSEY

GENERAL ARRANGEMENT

2

er Policy Commission

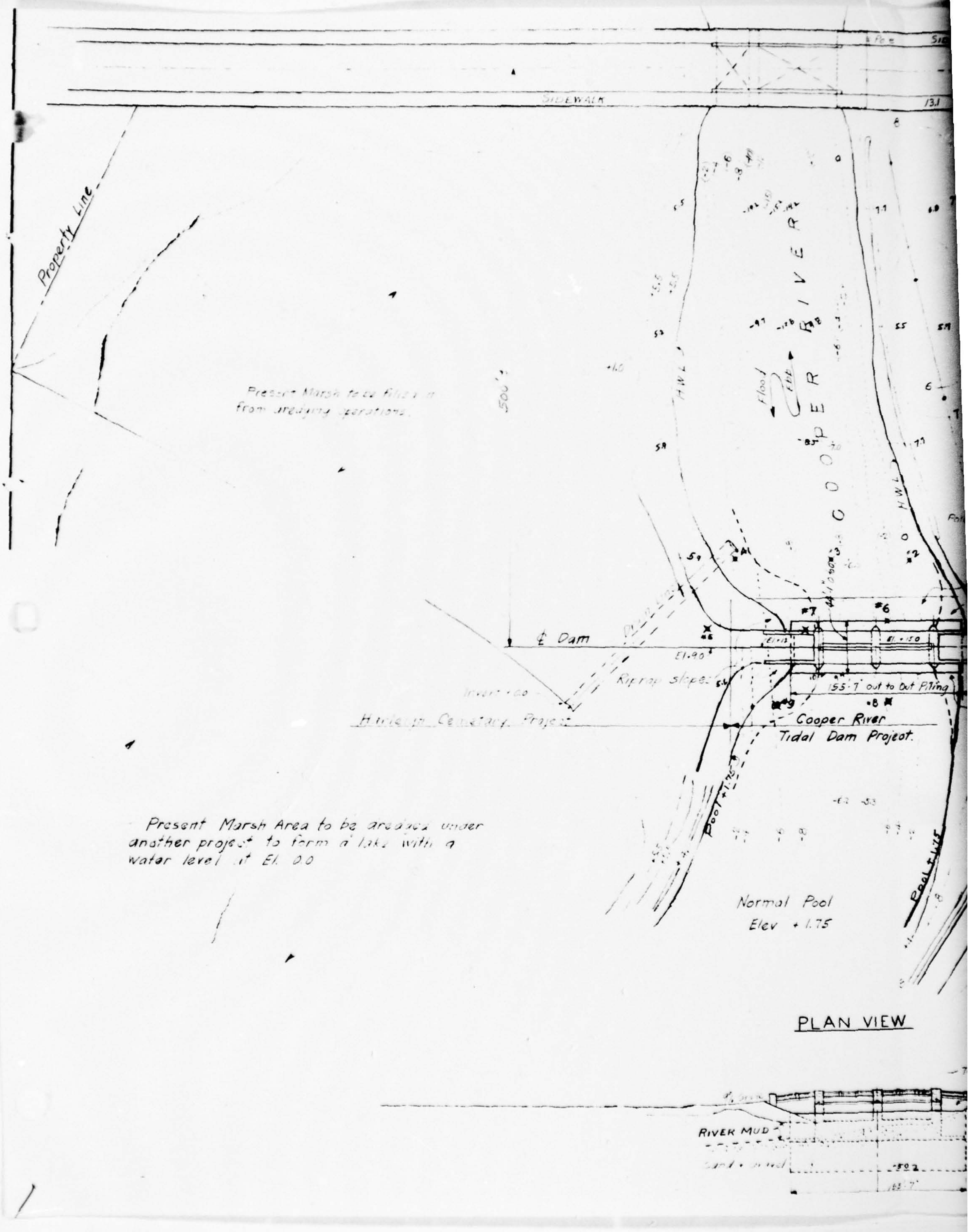
JUN 15 1938

Critchlow

CATION No 305

SION

2 3



SIDEWALK
Property Line
Present Marsh to be filled in from dredging operations.
500'±
COOPER RIVER
H.W.L.
Flood
Ebb
℄ Dam
El. +9.0
Riprap slopes
Invert +0.0
Harleigh Cemetery Project
155'-7" out to out Piling
Cooper River Tidal Dam Project
Present Marsh Area to be dredged under another project to form a lake with a water level at El. 0.0
Normal Pool Elev + 1.75
Pool + 1.75
RIVER MUD

PLAN VIEW

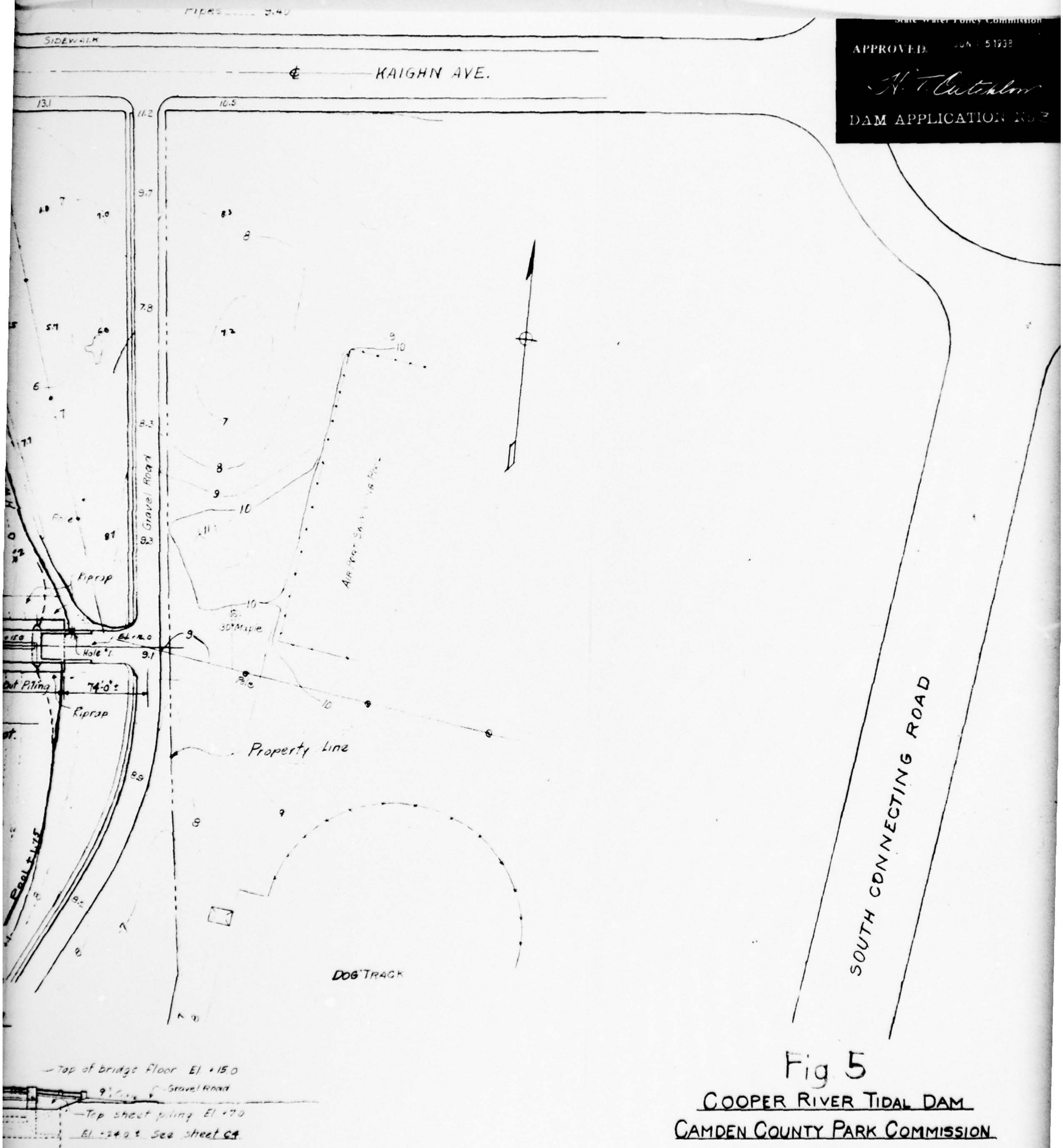


Fig 5

COOPER RIVER TIDAL DAM

CAMDEN COUNTY PARK COMMISSION

STATE OF NEW JERSEY

GENERAL ARRANGEMENT

LOCATION PLAN


Airport
2
3

Check List
Visual Inspection
Phase 1

Name Dam Cooper River Parkway County Camden State New Jersey Coordinators N.J. D.E.P.

Date(s) Inspection June 14,21,28 July 19,1978 Weather Sunny Temperature $80^{\circ}F$

Pool Elevation at Time of Inspection 2.0± M.S.L. Tailwater at Time of Inspection 1.7± M.S.L.

Inspection Personnel:

K. Jolls	R. Lang	C. Hoffman
M. Carter	H. Grout	(Mr. Neville Courtney - designer of dam)
T. Chapter		

K. Jolls Recorder

CONCRETE/MASONRY DAMS

SHEET 2

ISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE OR LEAKAGE	None observed.	Only a few inches head differential at time of inspection.
RUCTURE TO BUTMENT/EMBANKMENT JNCTIONS	Concrete bridge with road approaches.	
AINS	Drain pipe behind west abutment. (inlet and outlet submerged)	Regulates water level in cemetery lagoon.
TER PASSAGES	N/A	
UNDATION	Steel sheet piling.	See contract plans.

CONCRETE/MASONRY DAMS

SHEET 3

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Some spalling at piers. (at bases - brackish water)	All concrete in sound condition.
STRUCTURAL CRACKING	Yes (minor)	
VERTICAL AND HORIZONTAL ALIGNMENT	Ok. No settlement	
MONOLITH JOINTS	Ok	Good condition.
CONSTRUCTION JOINTS	Ok	

EMBANKMENT

SHEET 4

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Minor surface erosion. (poor maintenance)	Erosion not caused by flood currents.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Minor	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Ok	Crest of embankment at abutment aproaches (Elevation 12±).
RIPRAP FAILURES	None	

EMBANKMENT

ISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
UNCTION OF EMBANKMENT ND ABUTMENT, SPILLWAY ND DAM	Ok	2.5:1 fill slopes at abutments.
NY NOTICEABLE SEEPAGE	Yes	Large drain at west abutment (behind it).
TAFF GAGE AND RECORDER	None	
RAINS	None	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None (see gated spillway)	
INTAKE STRUCTURE		
OUTLET STRUCTURE		
OUTLET CHANNEL		
EMERGENCY GATE	None	

SHEET 7

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None	
APPROACH CHANNEL		
DISCHARGE CHANNEL		
BRIDGE AND PIERS		

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Submerged.	
APPROACH CHANNEL	Minor breaching of Levee separating the approach channel from a shallow lagoon to the west.	
DISCHARGE CHANNEL	Cooper River Natural Banks Levee built on west bank (fill)	
BRIDGE AND PIERS	Ok (Main superstructure of dam carried over tidal gates).	
GATES AND OPERATION EQUIPMENT	2 hydraulic gates (operable) 45±' wide. 18-2' x 3'± flap gates in movable gates.	Bottom constantly submerged.

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	Height gages at each tidal gate.	Indicates vertical altitude of gate.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Tidal base from Delaware River. Perimeter slopes flat except at right abutment bank.	
SEDIMENTATION	None observed.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	No obstructions.	
SLOPES	Satisfactory	
APPROXIMATE NO. OF HOMES AND POPULATION	Appears to be very few (unless in tidal zones). Mainly industrial/commercial.	Determine downstream habitation.
OTHER:	Dam also called "Kaighn Avenue" dam. Original hoisting equipment vandalized.	

SHEET 1

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
COOPER RIVER PARKWAY DAM

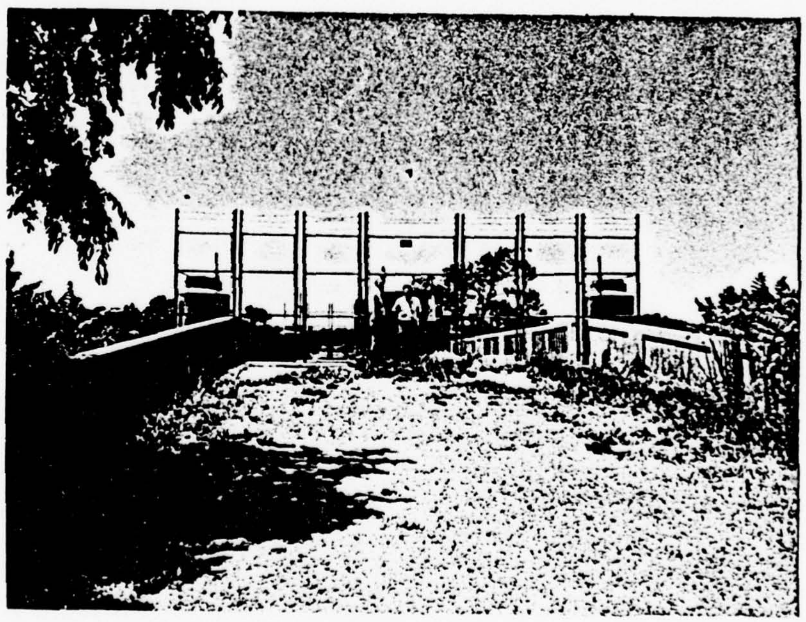
ITEM	REMARKS
PLAN OF DAM	Partial plans available - Camden County Park Commission
REGIONAL VICINITY MAP	Available
CONSTRUCTION HISTORY	1940 Only date known (from NJ. D.E.P. records) No records or as-builts.
TYPICAL SECTIONS OF DAM	Available
HYDROLOGIC/HYDRAULIC DATA	Not available
OUTLETS - PLAN	Available
- DETAILS	Available
-CONSTRAINTS	N/A
-DISCHARGE RATINGS	Not available
RAINFALL/RESERVOIR RECORDS	Not available

ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	None available
DESIGN COMPUTATIONS	Not available
HYDROLOGY & HYDRAULICS	Not available
DAM STABILITY	Only summary of forces available
SEEPAGE STUDIES	None available
MATERIALS INVESTIGATIONS	Not available
BORING RECORDS	Not available
LABORATORY	Not available
FIELD	Not available
POST-CONSTRUCTION SURVEYS OF DAM	Unknown
BORROW SOURCES.	Unknown

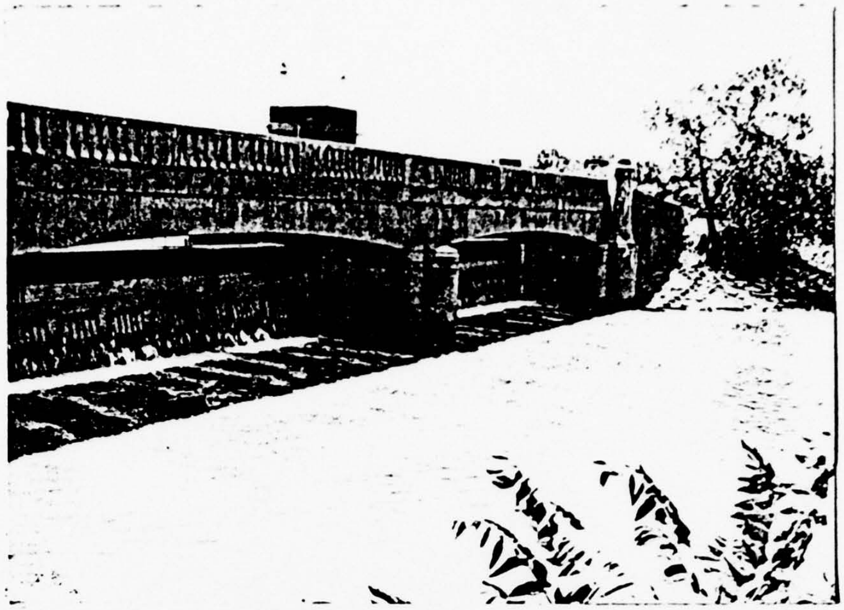
ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	Tidal gates hoist mechanism revised 1975
HIGH POOL RECORDS	None. Record High Tide = 8.9
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None
MAINTENANCE OPERATION RECORDS	None available

ITEM	REMARKS
SPILLWAY PLAN	Available (original plans)
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	None available except 1975 revisions.

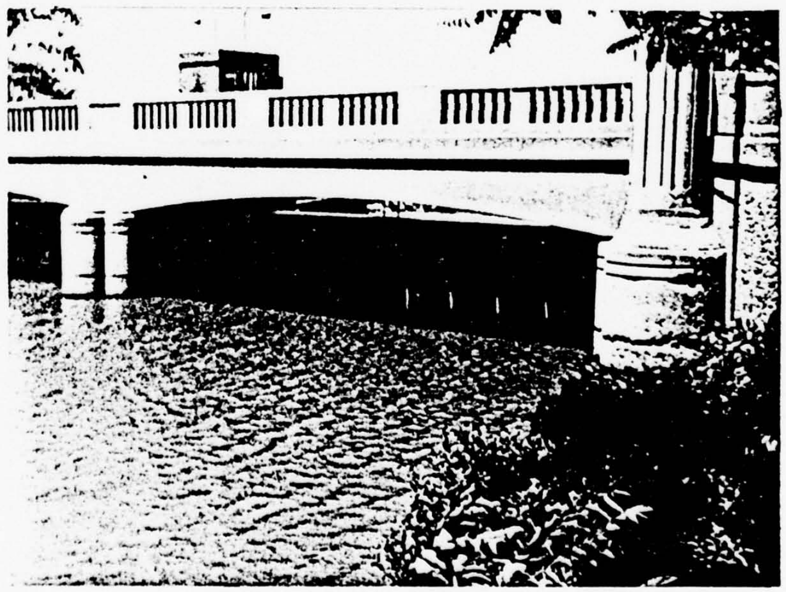
Upstream view of Structure
June 1978



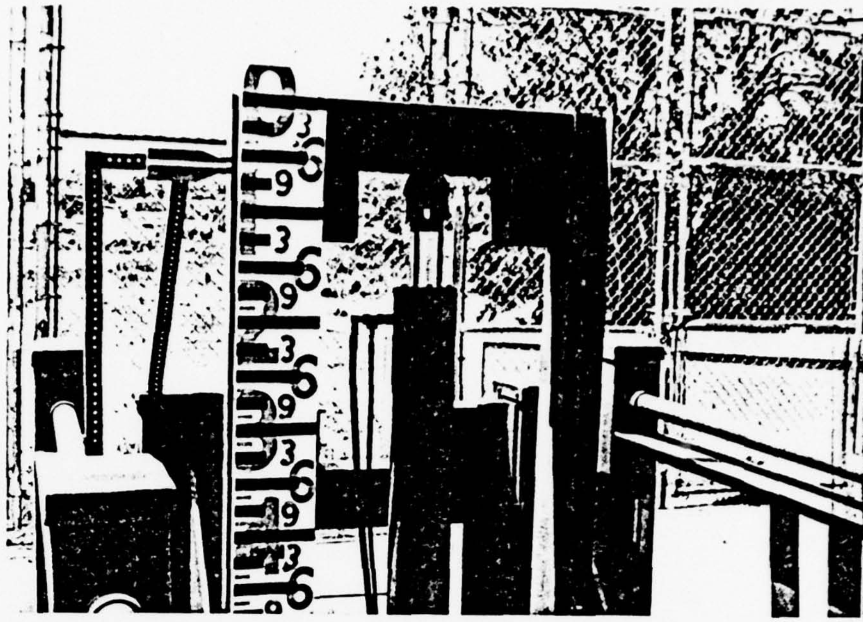
East Abutment
June 1978



Downstream view of Sluicegates
June 1978



Upstream of Sluicegates and East Abutment
June 1978



Hydraulic Cylinder
July 1978

Lifting Apparatus
July 1978

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Area = 37.0 Square Miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): +1.75 (Above M.S.L) 1150 Acre feet

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: +9.0 (M.S.L.)

ELEVATION TOP DAM: +9.0 (M.S.L.)

CREST:

a. Elevation +9.0 (tidal gates in closed position)
b. Type Vertical lift tidal gates
c. Width 3 Feet
d. Length 2 @ 45'
e. Location Spillover Stream Channel Cooper River
f. Number and Type of Gates 2 hydraulic gates

OUTLET WORKS:

a. Type 24 x 36 inch Sluice gates
b. Location 9 in each hydraulic lift gate
c. Entrance inverts +1.75 (Above M.S.L.)
d. Exit inverts +1.75 (Above M.S.L.)
e. Emergency draindown facilities None

HYDROMETEOROLOGICAL GAGES:
a. Type None near damsite
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 8500 c.f.s.

BY D.J.M DATE 9-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A1 OF

CHKD. BY DATE COOPER RIVER PARKWAY INSPECTION PROJECT C222

SUBJECT PRECIPITATION DATA AS USED IN HEC 1 INPUT

Drainage area = 37 sq miles

PMP = 26" 6 hours

Adjustment for drainage area & fit factor $\approx 26 \times 0.89 \times 0.83 \approx 19.21''$

Time	%	Rainfall	Δ	Re Δ	$\Sigma\Delta$	Runoff Curve=60	Δ Runoff
1	49	9.41	9.41	1.35	1.35	0	0
2	65	12.48	3.07	1.73	3.08	0.38	0.38
3	76	14.60	2.12	2.12	5.20	1.41	1.03
4	85	16.33	1.73	9.41	14.61	8.80	7.39
5	93	17.86	1.53	3.07	17.68	11.70	2.90
6	100	19.21	1.35	1.53	19.21	13.20	1.50

Time of concentration:

length of watercourse = 5.23 miles

difference in Elevation $\approx$ 10'

$$T_c = \left(\frac{11.9 \times 5.23^3}{10}\right)^{0.385} = 7.22 \text{ hours}$$

$$T_p = \frac{D}{2} + 0.6 \times 7.22 = 4.83 \text{ hours}$$

$$T_s = \frac{T_p}{0.85} = 5.68 \text{ hours}$$

$$Lag \approx 5.68 - \frac{D}{2} = 5.18 \text{ hours}$$

HD-7
(10-55)
Bureau of Reclamati n

DERIVATION OF DIMENSIONLESS OR APPLIED UNITGRAPH

Unitgraph {derived from / for application to} COOPER RIVER PARKWAY

Unit time, t_r = 1 hrs. lag = 5.18 hrs. t_s = lag + ½ t_r = 5.68

Area = 37 sq. mi. DSF {observed / for 1 inch, = 26.89 X area} 994.93

Comp. by DJM Ck. by ______ Date 9-78

Hours	% t_s $\left(\frac{100}{t_s}\right)$ =	Dimensionless ordinate $Q\frac{t_s}{DSF}$	Q cfs $\left(\frac{DSF}{t_s}=175.16\right)$		
1	17.6	1.4	245		
2	35.2	6.3	1104		
3	52.8	13.4	2330		
4	70.4	19.3	3381		
5	88.0	20.8	3643		
6	106.0	18.7	3276		
7	123.0	14.7	2575		
8	141.0	11.1	1944		
9	158.0	8.4	1471		
10	176	6.1	1068		
11	194	4.5	788		
12	211	3.2	561		
13	229	2.3	403		
14	246	1.7	298		
15	264	1.25	219		
16	282	0.88	154		
17	299	0.68	119		
18	317	0.48	84		
19	335	0.37	65		
20	352	0.27	47		
21	370	0.22	38		
22	387	0.18	31		
23	405	0.14	25		
24	423	0.11	19		

SCS Curvilinear Dimensionless Graph

 A 3

T₀	0	1	2	3	4	5	6	7	8	9
0	0.0	0.0	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4
10	0.4	0.5	0.6	0.7	0.9	1.0	1.2	1.3	1.4	1.6
20	1.8	2.0	2.2	2.5	2.8	3.1	3.3	3.6	3.9	4.2
30	4.5	4.8	5.1	5.4	5.8	6.2	6.5	6.9	7.2	7.6
40	8.0	8.4	8.8	9.2	9.6	10.0	10.4	10.8	11.3	11.7
50	12.2	12.6	13.1	13.5	14.0	14.5	14.9	15.2	15.6	16.0
60	16.4	16.7	17.0	17.3	17.7	18.0	18.2	18.5	18.7	19.0
70	19.2	19.4	19.6	19.8	20.0	20.2	20.3	20.4	20.5	20.7
80	20.8	20.8	20.9	20.9	21.0	21.0	20.9	20.9	20.8	20.8
90	20.7	20.6	20.5	20.5	20.4	20.3	20.2	20.1	20.0	19.9
100	19.8	19.6	19.4	19.2	19.1	18.9	18.7	18.5	18.3	18.1
110	17.9	17.6	17.4	17.1	16.9	16.6	16.4	16.2	16.0	15.7
120	15.5	15.2	15.0	14.7	14.5	14.2	14.0	13.8	13.6	13.4
130	13.2	13.0	12.8	12.6	12.4	12.2	12.0	11.8	11.6	11.5
140	11.3	11.1	10.9	10.7	10.5	10.4	10.2	10.0	9.9	9.8
150	9.6	9.4	9.3	9.1	9.0	8.8	8.7	8.5	8.4	8.2
160	8.1	8.0	7.8	7.7	7.5	7.4	7.3	7.2	7.0	6.9
170	6.8	6.7	6.6	6.5	6.4	6.2	6.1	6.0	5.9	5.8
180	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.0	5.0	4.9
190	4.8	4.7	4.6	4.6	4.5	4.4	4.3	4.2	4.2	4.1
200	4.0	3.9	3.8	3.8	3.7	3.6	3.6	3.5	3.4	3.4
210	3.3	3.2	3.2	3.1	3.1	3.0	3.0	2.9	2.8	2.8
220	2.7	2.7	2.6	2.6	2.6	2.5	2.5	2.4	2.4	2.3
230	2.3	2.2	2.2	2.2	2.1	2.1	2.0	2.0	2.0	1.9
240	1.9	1.8	1.8	1.8	1.7	1.7	1.7	1.6	1.6	1.6
250	1.6	1.5	1.5	1.5	1.4	1.4	1.4	1.4	1.3	1.3
260	1.3	1.3	1.2	1.2	1.2	1.2	1.2	1.1	1.1	1.1
270	1.1	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.9	0.9
280	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7
290	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.6
300	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5
310	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4
320	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
330	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
340	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2
350	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
360	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
370	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1
380	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
390	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
400	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
410	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
420	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
430	0.1	0.1	0.1	0.0						

BY H. G. DATE

CHKD. BY DATE

LOUIS BERGER & ASSOCIATES INC.

SHEET NO. A 4

PROJECT C222

SUBJECT BUREAU OF RECLAMATION DEFINITION OF TERMS USED IN UNITGRAPH

L, LAG TIME AS DEFINED BY THE SCS IS THE TIME IN HOURS FROM THE MIDPOINT OF EXCESS RAINFALL, TO THE TIME OF PEAK DISCHARGE.

L, LAG TIME AS DEFINED BY THE BUREAU OF RECLAMATION IS FROM THE CENTRE OF MASS OF RAINFALL TO THE CENTER OF MASS OF RUNOFF.

Tc IS EQUAL TO $\left(\frac{11.9 L^3}{H}\right)^{0.385}$ FROM THE CALIFORNIA CULVERTS PRACTICE

SCS L IS APPROXIMATELY 0.6 Tc

EXAMPLES OF DETERMINING L (LAG) BY BUREAU OF RECLAMATION DEFINITION.

$$L = \frac{T_p - (D/2)}{0.85}$$ WHERE D IS THE TIME INTERVAL OF THE UNITGRAPH

THE SCS CURVILINEAR UNIT HYDROGRAPH CAN BE DERIVED BY FIRST TAKING BUREAU OF RECLAMATION L, (LAG) PLUS $\frac{D}{2}$ AFTER BEING DIVIDED BY 100, THEN MULTIPLIED BY EACH ABSCISSA (IN HOURS) BY THE QUOTIENT. THEN READING THE DIMENSIONLESS ORDINATE FOR THE GIVEN PERCENTAGES FROM THE PREVIOUSLY DETERMINED SCS CURVILINEAR DIMENSIONLESS GRAPH, (COPY ATTACHED)

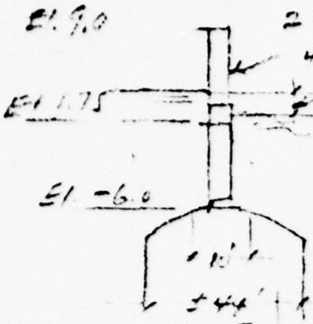
TO OBTAIN Q IN CFS FOR EACH ORDINATE MULTIPLY EACH DIMENSIONLESS ORDINATE BY A FACTOR OBSERVED FOR ONE INCH,

26.89 X AREA

BY SJH DATE 7-27-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A5 OF 25

CHKD. BY ______ DATE ______ Cooper River Parkway ... PROJECT ______

SUBJECT Discharge thru Tidegates



2 ea 45' x 15' Tide gate fixed wheel.

Differential head

2 sets of 9 each 3' x 2' flap gates $L = 54$ $A = 108$ sq ft

Gate opening		0.25	0.50	1.0	2.0	3.0	4.0	Flapgate Unsubmerged	Flap gates Submerged
Area		22.5	45.0	90.0	180.0	270.0	360.0		108
C		0.70	0.71	0.72	0.73	0.74	0.75	-	0.65
Differential Head	V	Q	Q						
0.25	4.01	63	128	260	527	801	1083	20	281
0.5	5.67	89	181	367	745	1133	1531	59	398
1.0	8.02	126	256	520	1054	1602	2165	167	563
2.0	11.35	179	363	735	1491	2268	3065	473	797
3.0	13.90	219	444	901	1826	2777	3753	776	976
4.0	16.05	253	513	1040	2109	3207	4334	986	1127
5.0	17.94	283	573	1163	2357	3584	4844	1176	1259
6.0	19.66	310	628	1274	2583	3928	5308	1316	1380
7.0	21.73	334	678	1375	2790	4242	5732	1463	1490

Flap gate sluices - Submerged flow $c = 0.65$

$Q = CAV$

Unsubmerged flow

$Q = \frac{2}{3}\sqrt{2g}\,C\left(H_1^{3/2} - H_2^{3/2}\right)$

$C \sim$ see Small Dams Fig 257 P 386

If gates can be opened to 10' and differential head is 5'

$Q = \frac{2}{3} \times \sqrt{2g} \times C \times L\left(H_1^{3/2} - H_2^{3/2}\right)$

$= 5.35 \times .68 \times 90\left(15^{3/2} - 5^{3/2}\right) = 15,360$ c.f.s.

For 2' differential head and 10' opening Bottom of gate El. +4 W.S. EC +6 Tailwater El. +4

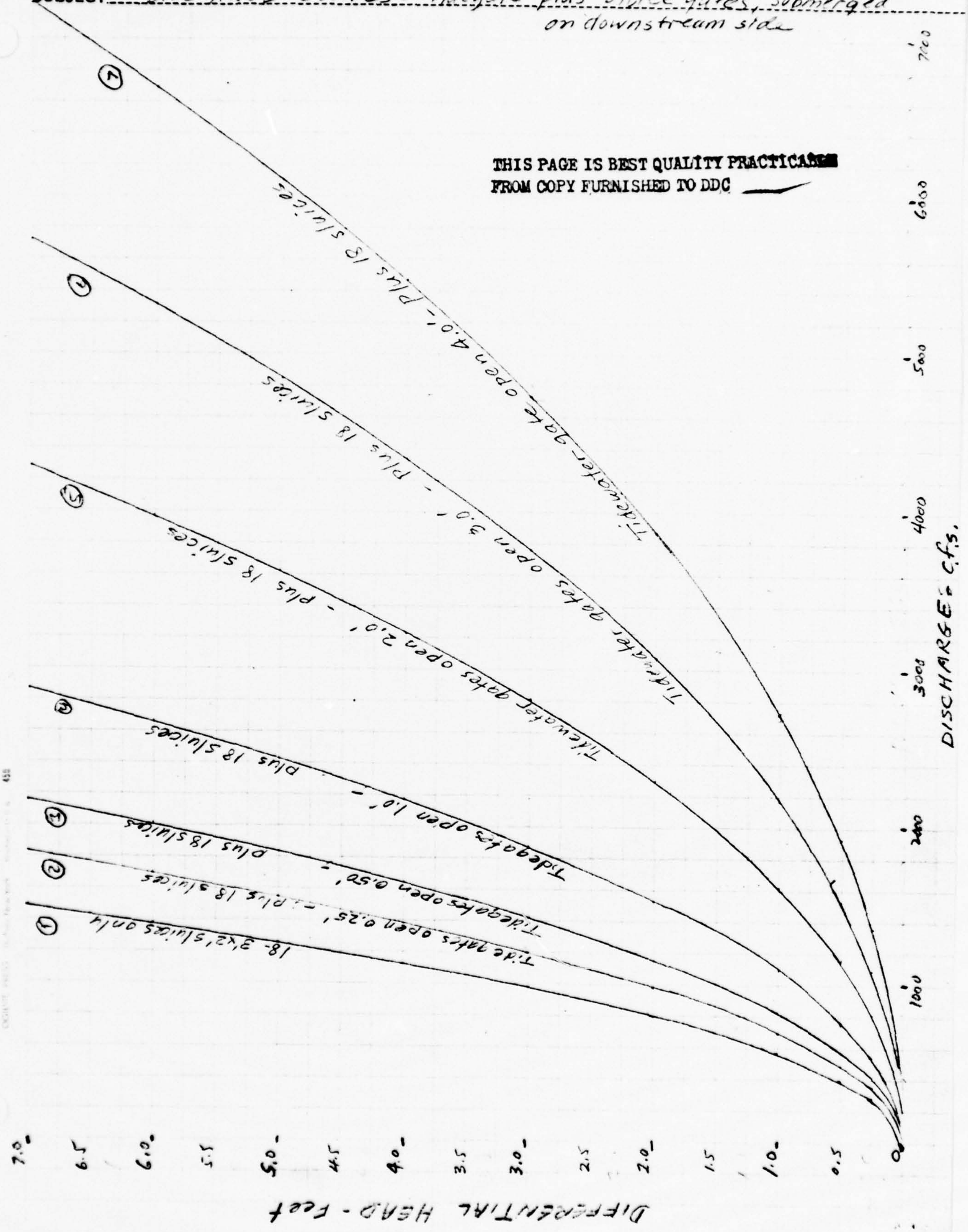
$A = 900$ $v = 11.35$ $c = 0.75$ $Q = 7660$

For full opening of gates ... W.S. EL +4 $H = 10$ ... $Q = 2.5 \times 90 \times 10^{3/2} = 7100$

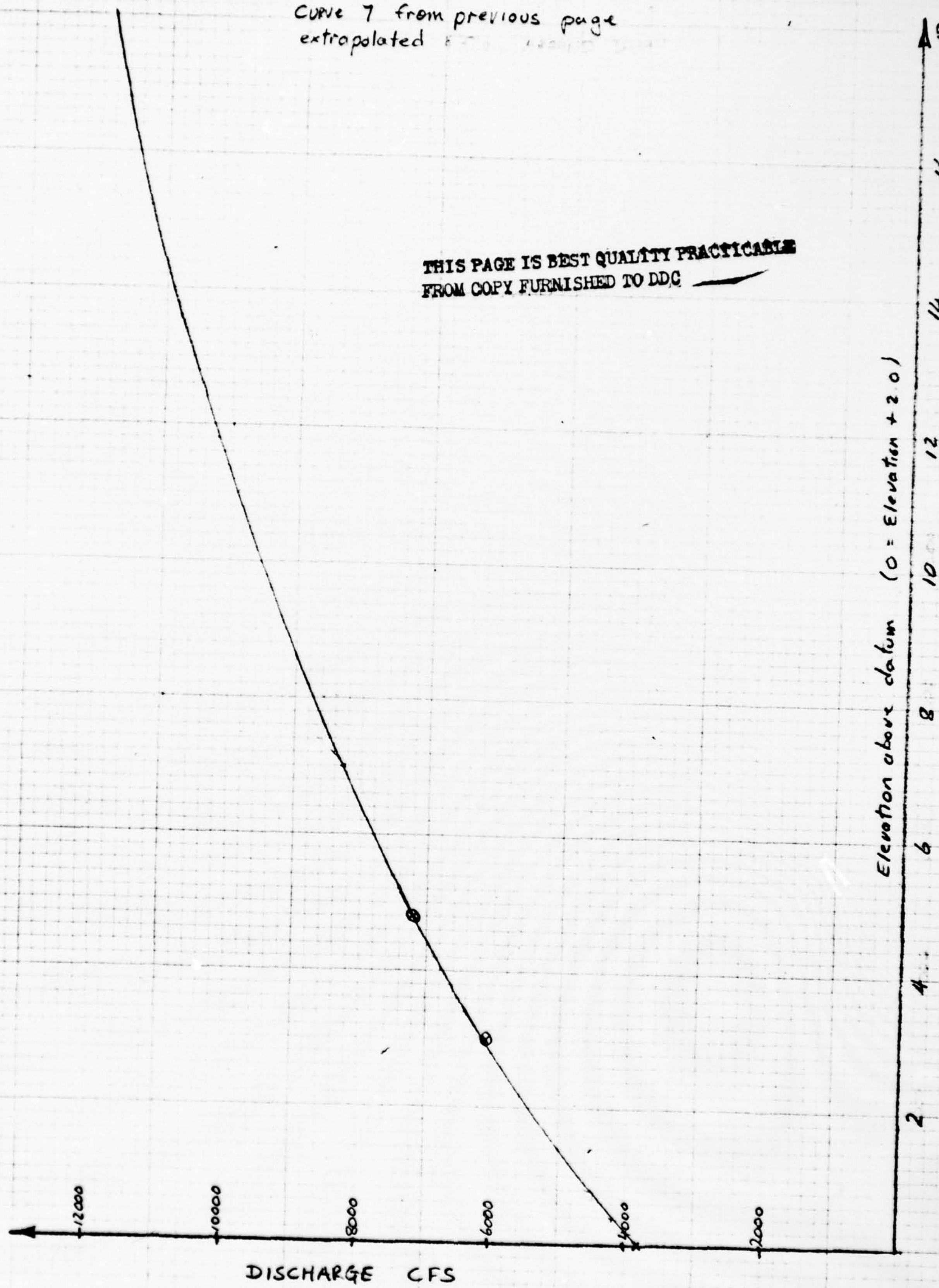
BY COH DATE 7-27-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A6 OF

CHKD. BY ______ DATE ______ Cooper River Parkway Dam PROJECT ______

SUBJECT DISCHARGE CURVES - Tidegate plus sluice gates, submerged on downstream side



Curve 7 from previous page
extrapolated



BY RJM DATE 9-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A8 OF
CHKD. BY DATE Croton River Parkway Dam PROJECT C222
SUBJECT Discharge Capacity

above El 9.0 (approx) The water will flow around the dam.

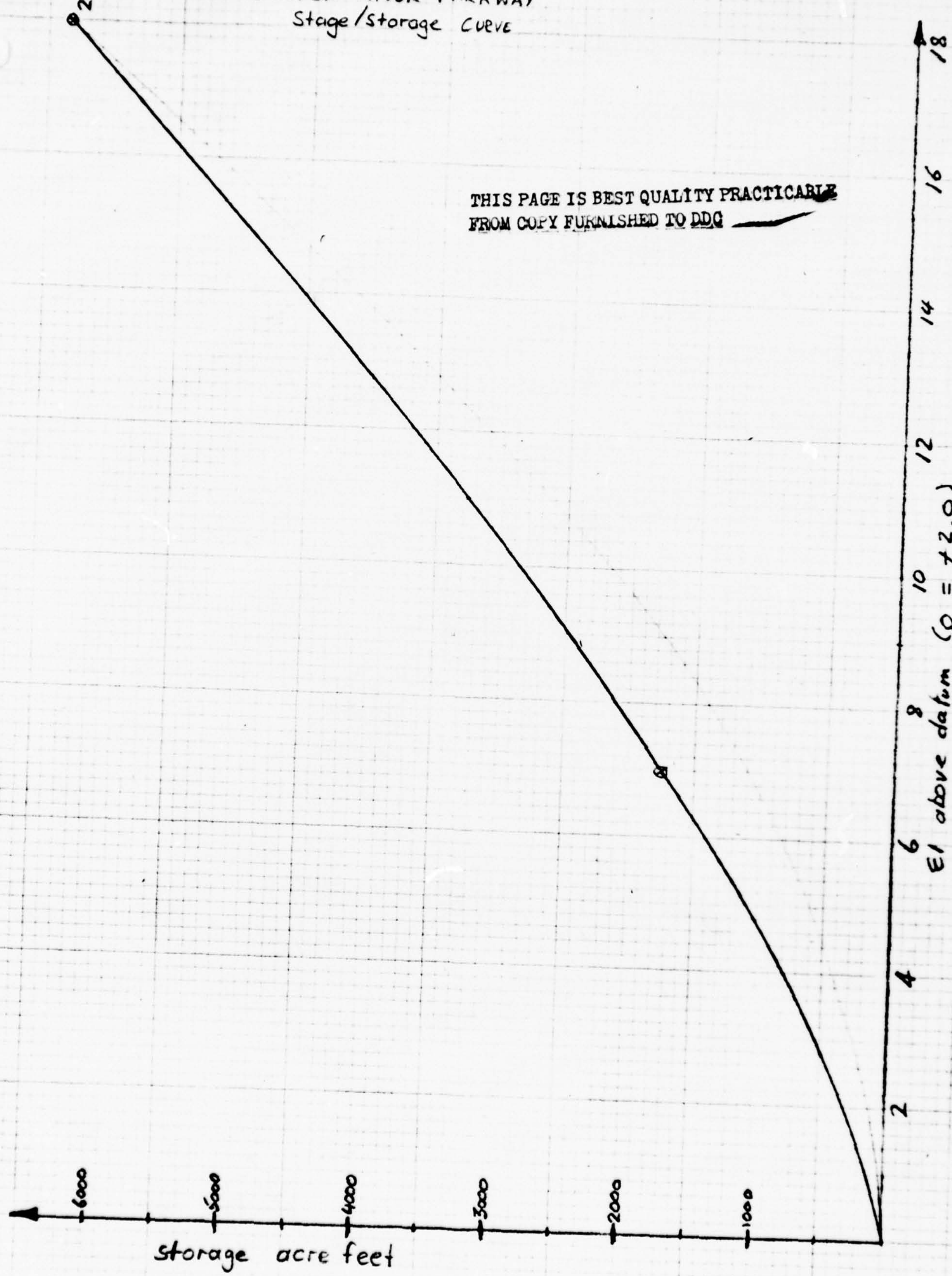
Assume flow under bridge will be negligible

length of flow around dam ≈ 1500'
take c = 1.5±
El relative to datum (⊘ = El +2.0)

El	DISCHARGE	DISCHARGE around dam + gates
7	0	8,300
8	2250	10,970
9	6364	15,544
10	11691	21,041
11	18000	27,900
12	25156	35,406

Cooper River Parkway

Stage/storage Curve



BY D.L.M DATE 9-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A10 OF

CHKD. BY DATE PROJECT C222

SUBJECT

Storage capacity

taking datum of 0 @ El. +2.0

Storage at this point = 1150 acre feet (take as 0)

@ El. 9.0 Storage = 2900 acre feet

Δ Storage = 1750 acre feet

@ El 20.0 area ≈ 640 acres

@ El. 9.0 area ≈ 190 acres

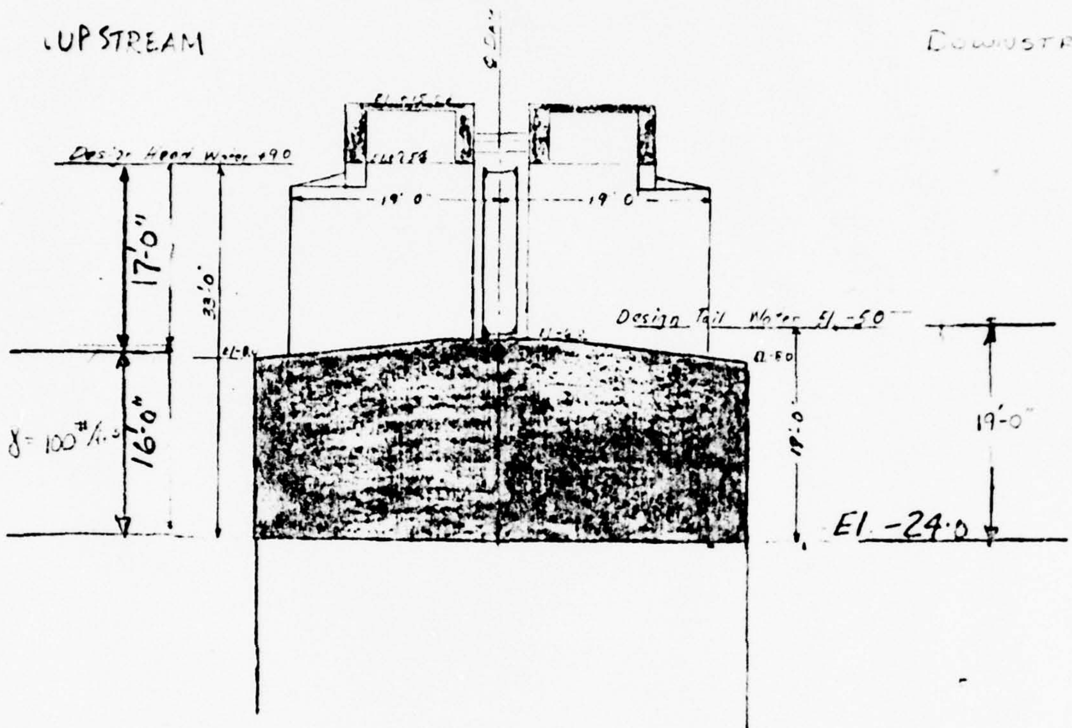
$$\Delta \text{ Storage} \approx \frac{(640+190)}{2} \times 11 \approx 4565 \text{ acre feet}$$

plotted on preceding page

Discharge & Storage at Elevations relative to datum :-

El	Storage	Discharge cfs
0	0	3850
3	520	6100
5	1100	7200
7	1750	8300
8	2100	10,970
9	2490	15,544
10	2850	21,041
11	3260	27,900

STABILITY CHECK AT EL. -24.0

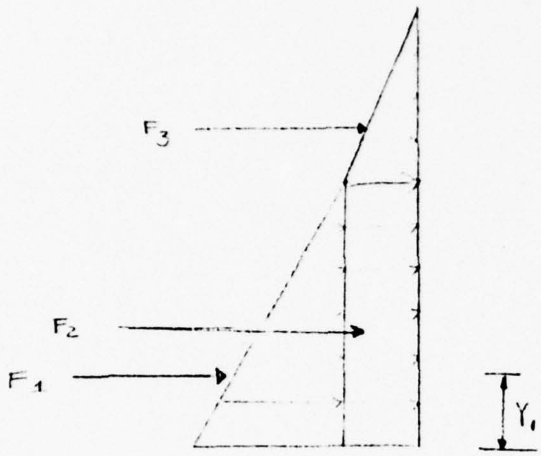


HORIZONTAL PRESSURES

UPSTREAM PRESSURES

$62.4^{\#}/ft^3 \cdot 33' = 2059^{\#}/ft^2$ WATER PRESSURE + $16 \times 37.6 \rightarrow (K_Y)$ $= 602^{\#}/ft^2$ EFFECTIVE SOIL PRESSURE = $2661^{\#}/\square'$ TOTAL PRESSURE

UPSTREAM PRESSURES (Cont.)



2059 #/ft² + 1600 #/ft² = 2661 #/ft²

K = 602/1600

K = .376

$F_1 = \frac{1}{2} \cdot 16 ft \times 1600\ \#/ft^2 = 12800\ \#/l.ft$ $\quad Y_1 = \frac{16}{3} = 5.33'$

$F_2 = 17 ft \times 62.4\ \#/ft^3 \times 16 ft = 169[illegible]\ \#/l.ft$ $\quad Y_2 = \frac{16}{2} = 8.0'$

$F_3 = \frac{1}{2}(62.4\ \#/ft^3 \times 17 ft)(17 ft) = 9016.8\ \#/l.ft$ $\quad Y_3 = 16 + \frac{17}{3} = 21.67'$

$\Sigma F_{UPSTREAM} = 38790\#$

DOWNSTREAM PRESSURES

$F_4 = (1185.[illegible]\ \#/ft^2 \times 19 ft)\frac{1}{2} = 11,263.2\ \#/l.ft$; $Y_4 = \frac{19}{3} = 6.33'$

TOTAL HORIZONTAL PRESSURE

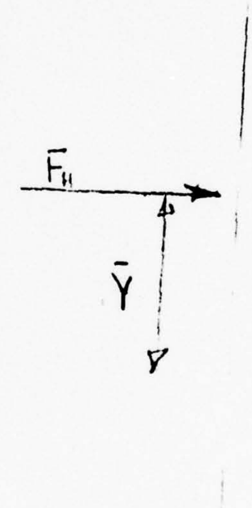
$$F_H = \Sigma F_{UP\,STREAM} - \Sigma F_{DOWN\,STREAM}$$

$$= 38790 - 11263$$

$$= 27526\,\#/\text{LIN FT.}$$

$$\bar{Y} = \frac{12.8 \times 5.33 + 16.9728 \times 8.0 + 9.016 \times 21.67 - 11.263 \times 6.33}{27.526}$$

$$= 11.92\ \text{FT.}$$

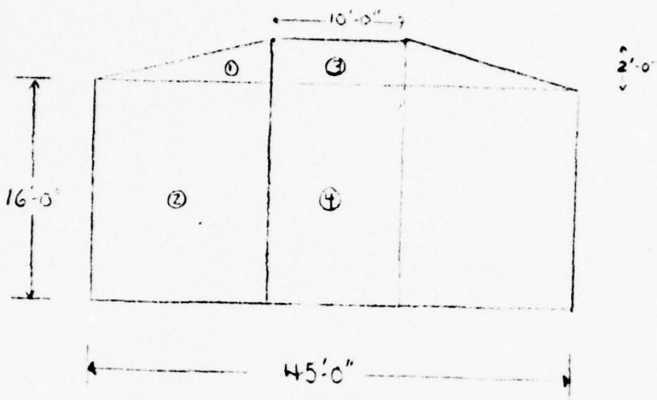


EL. -24.

DETERMINATION VERTICAL FORCES

a) FOOTING

AREA of CONCRETE



$A_{①} = \frac{1}{2} \cdot 2' \times 17.5' \; 17.5 ft^2$

$A_{②} = 17.5' \times 16' = 280 ft^2$

$A_{③} = 2' \times 10' = 20 ft^2$

$A_{④} = 16' \times 10' = 160 ft^2$

$A_{TOTAL} = 2A_{②} + 2A_{①} + A_3 + A_4$

$= 2(280 ft^2) + 2(17.5 ft^2) + 20 ft^2 + 160 ft^2$

$A_{TOTAL} = 775 ft^2$

WGT of CONCRETE FOOTING

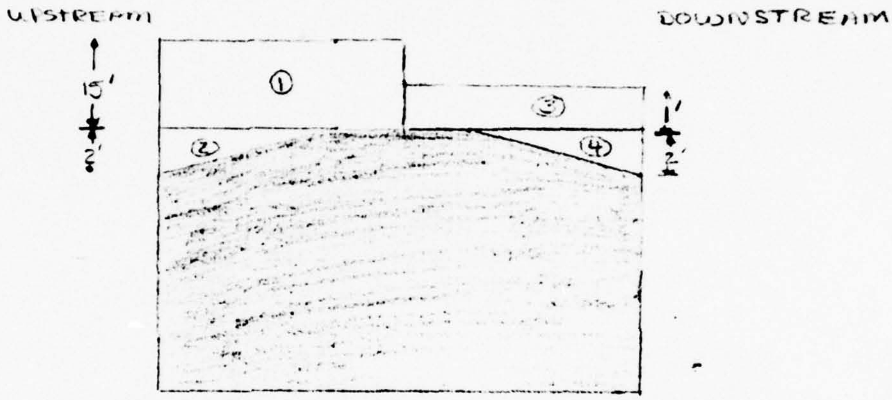
$^{1k}/_{1000\#} \cdot 150 \; ^{\#}/_{ft^3} \times 775 \; ft^2 \quad 116 \overset{.25}{} \; kips/_{l.ft}$

DETERMINATION OF WEIGHT OF STRUCTURE (CONT)

(b) Wgt of GATE STRUCTURE $= 200^k$

$200^k / 45 ft = 4.44^k/lin\ ft$

(c) Wgt of water



UPSTREAM

$A_{TOTAL(u)} = A_{①} + A_{②}$

$A_{①} = 22.5' \times 15' = 337.5 ft^2$

$A_{②} = 2' \times 17.5' (\frac{1}{2}) = 17.5 ft^2$

$A_{TOTAL} = 355 ft^2$

Wgt of water - UPSTREAM

$Wgt = 355 ft^2 \times 62.4^{\#}/ft^3 \times {}^{1k}/_{1000\#} = 22^k/lin\ ft$

Wgt of WATER - DOWNSTREAM

$A_{TOTAL(d)} = A_{(3)} + A_{(4)}$ $\qquad A_3 = 1 \times 22.5' = 22.5\ ft^2$

$A_4 = A_{(2)} = 17.5\ ft^2$

$A_{TOTAL(d)} = 40\ ft^2$

$Wgt_w = 40\ ft^2 \times 62.4\ \#/ft^3 \times 1\ kip/1000\# = 2.496\ kips/lin\ ft$

(1) Wgt of Sheet Piling

LENGTH OF PILING = 31' TYPE MP116 @ 36 #/ft

$Wgt = 31' \times 36\ \#/ft\ (2) \times 1k/1000\# = 2.23\ kips/lin\ ft$

(2) Wgt of Deck and RAILING

$RAILING = 2 \cdot 3.4' \times .8' \times 150\ \#/ft^3 \cdot 1k/1000\# = .82\ k/ft$

$DECK = 4 \cdot 150\ \#/ft^3 \left[7\ ft \times 1.5\ ft + \frac{.75'(8.5)}{2} \right] 1k/1000\# = 8.21\ k/lin\ ft$

ADD FOR WT OF TRUSSES = $2\ k/ft.$

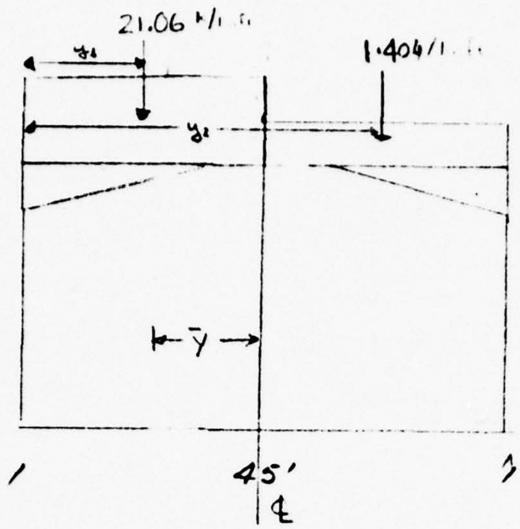
Deck + Railing = $11\ kips/ft$

TOTAL VERTICAL FORCES

Concrete Foundations:	116 k/ft
Wgt of Water Upstream:	22 k/ft
Wgt of water Downstream:	2.49 k/ft
Wgt of Sheet Piling:	2.2 k/ft
Wgt of Deck & Railing:	11.0 k/ft
Wgt of Gate Structure	4.4 k/ft

TOTAL = 158 k/lin ft

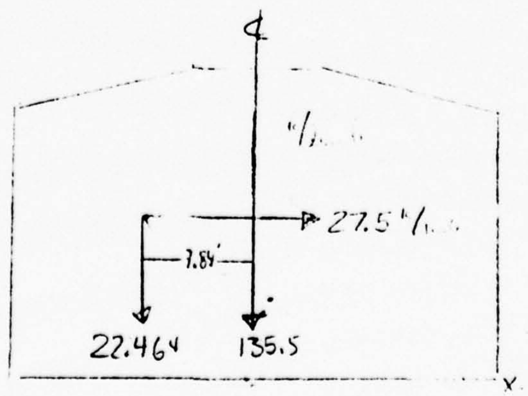
DETERMINATION OF C.G. OF VERTICAL FORCES



$y_1 = 11.25'$ $y_2 = 33.75'$

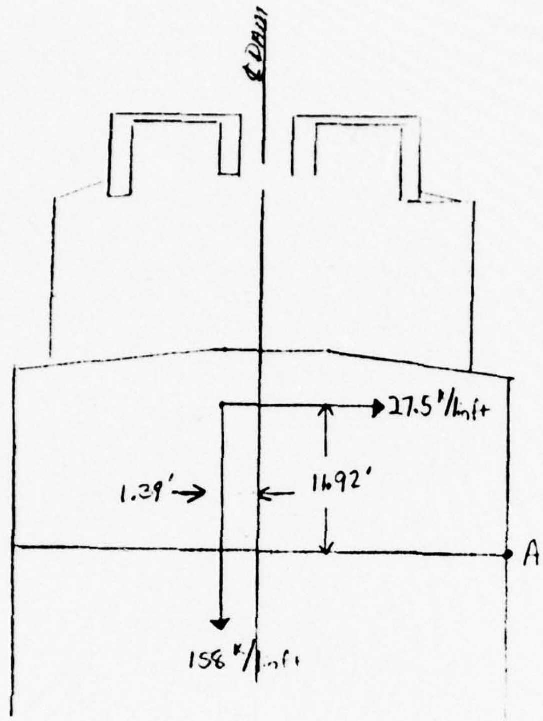
$$\bar{y} = \frac{11.25\,(21.06 - 1.404)}{22.464}$$

= 9.84 LEFT OF ℄



C.G. VERTICAL LOADS $= \frac{22.464 \times 9.84}{158} = 1.39'$ LEFT OF ℄

A



FACTOR OF SAFETY AGAINST OVERTURNING = $\dfrac{\text{RESISTING MOMENT}}{\text{OVERTURNING MOMENT}}$

$$F.S. = \frac{158^{k}/\text{lnft} \times (22.5' + 1.39')}{27.5^{k}/\text{lnft} \times 11.92'} = \frac{3774.62}{327.8}$$

F.S. = 11.5

ECCENTRICITY OF RESULTANT FORCE = $\dfrac{RM - OM}{V} = \dfrac{3774.62 - 327.8}{158}$

= 21.8 from downstream side

= 0.68 RIGHT OF ℄

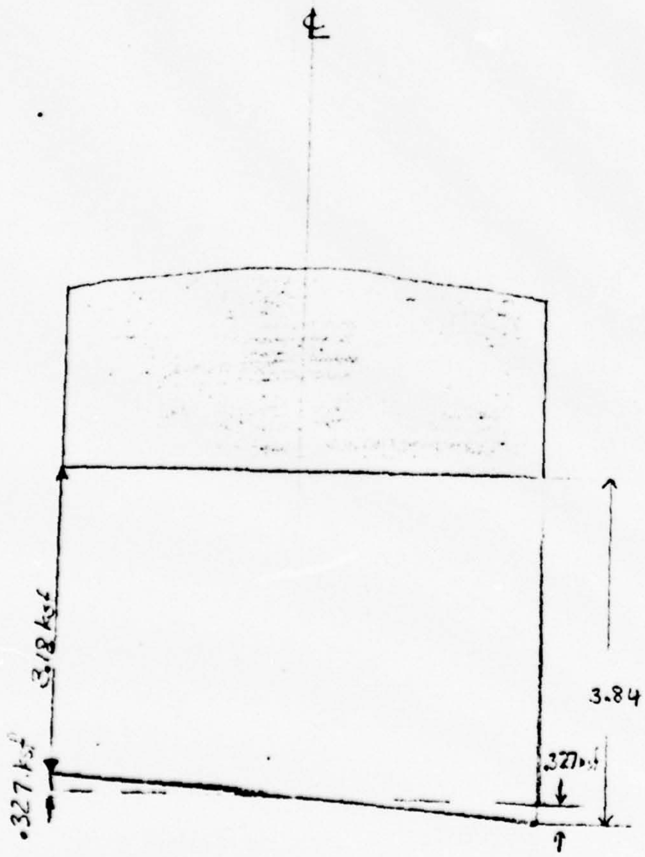
STRESSES ON CONCRETE

$$\sigma_{max} = \frac{V}{b}\left(1 + \frac{6e}{b}\right) = \frac{158}{45}\left(1 + \frac{6(.7)}{45}\right)$$

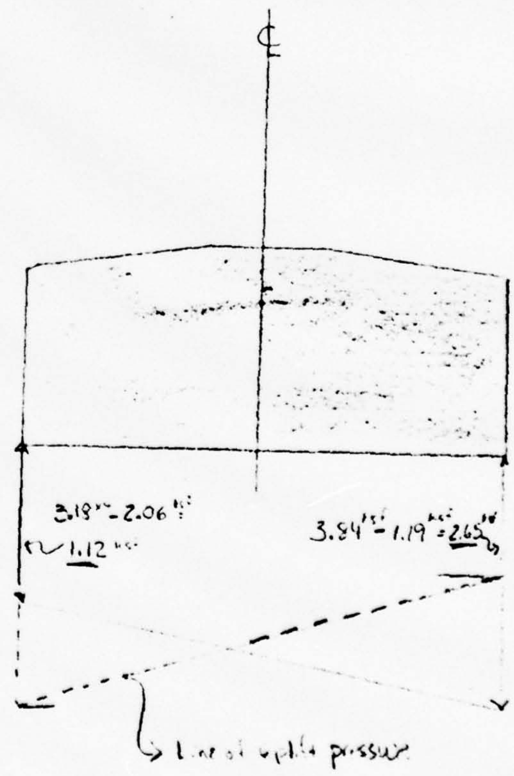
$$= 3.8 \text{ kips/ft}^2$$

$$\sigma_{min} = \frac{V}{b}\left(1 - \frac{6e}{b}\right) = 3.18 \text{ kips/ft}^2$$

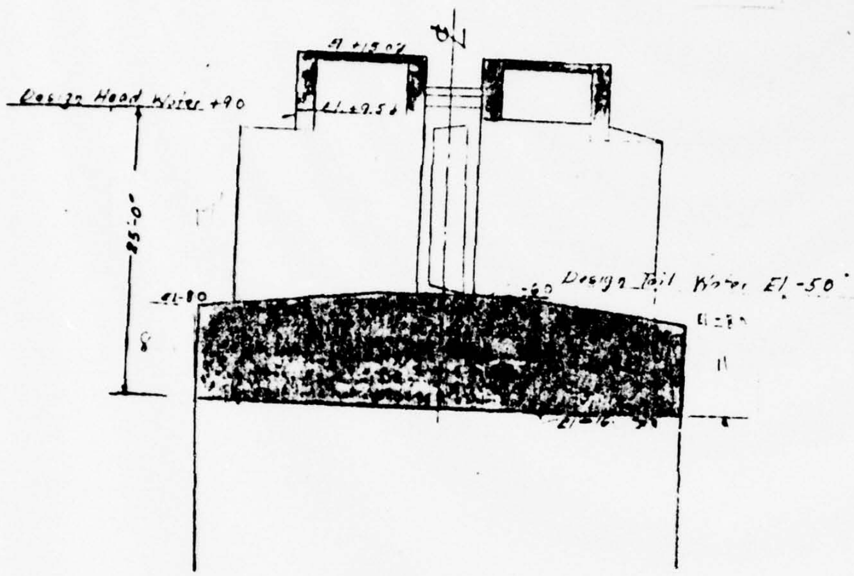
NO UPLIFT



UPLIFT

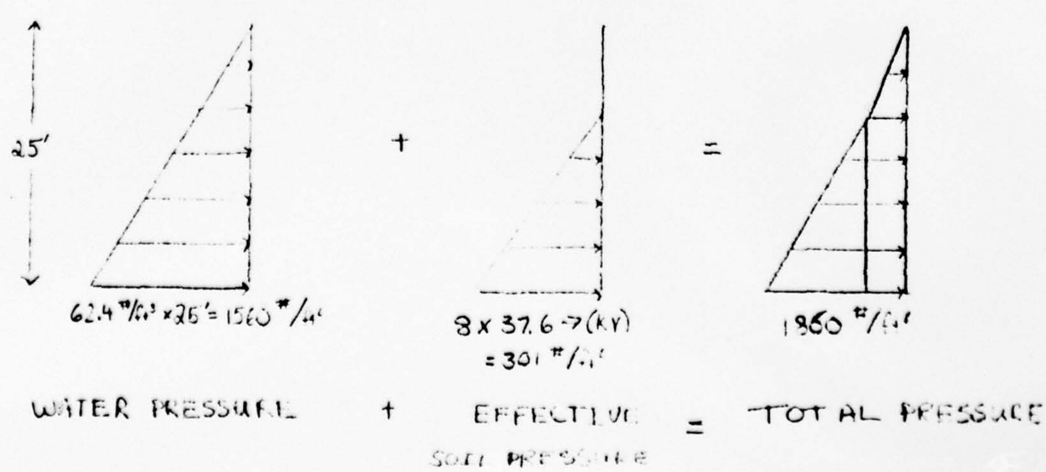


STABILITY CHECK AT El. -16.0



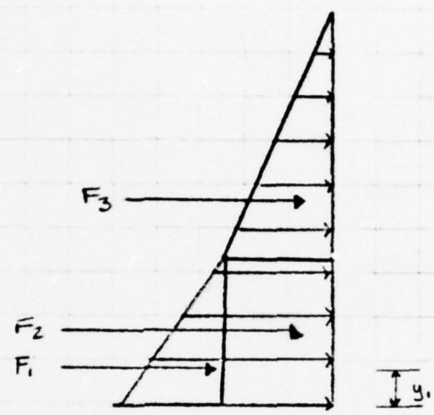
HORIZONTAL PRESSURES

UPSTREAM PRESSURES



BY LJB DATE 8-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A22 OF.
CHKD. BY ______ DATE ______ PROJECT C-222
SUBJECT COOPER RIVER TIDAL DAM - STABILITY ANALYSIS

UPSTREAM PRESSURES (Cont)



8×100#

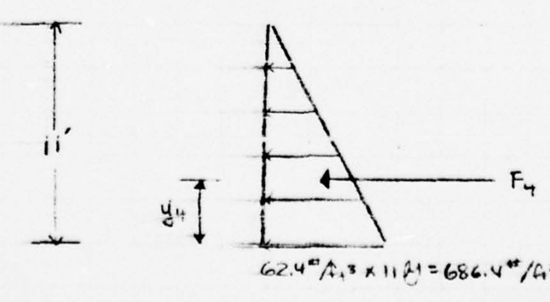
$F_1 = \frac{1}{2}(8')(800\ \#/ft^2) = 3200\ \#/\text{lin ft}$ $\qquad y_1 = \frac{8}{3} = 2.67'$

$F_2 = 17' \times 62.4\ \#/ft^3 \times 8' = 8486\ \#/\text{lin ft}$ $\qquad y_2 = 4'$

$F_3 = \frac{1}{2}\ 17' \times 62.4\ \#/ft^3 \times 17' = 9017\ \#/\text{lin ft}$ $\qquad y_3 = 8 + \frac{17}{3} = 13.67'$

$\Sigma F_{upstream} = 20.7$ kips/lin ft

DOWNSTREAM Pressures



$F_4 = (686.4\ \#/ft^2 \times 11\ ft \times \frac{1}{2}) = 3775.2\ \#/\text{lin ft}$ $\qquad y_4 = \frac{1}{3}\ 11 = 3.67'$

13

BY LJD DATE 8-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A23 OF

CHKD. BY ______ DATE ______ DAM INSPECTION PROJECT C-222

SUBJECT COOPER RIVER TIDAL DAM - STABILITY ANALYSIS

TOTAL HORIZONTAL PRESSURE

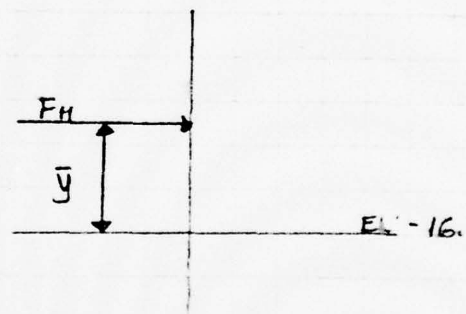
$$F_H = \Sigma F_{UPSTREAM} - F_{downstream}$$

$$= 20.7^k - 3.8^k$$

$$= 16.9^{k/\text{lin ft.}}$$

$$\bar{y} = \frac{3.2 \times 2.67 + 8.5 \times 4 + 9.0 \times 13.67 - 3.8 \times 3.67}{16.9}$$

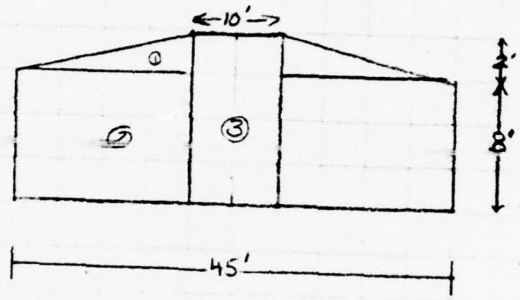
$$\bar{y} = 8.97 \text{ Ft.}$$



DETERMINATION VERTICAL FORCES

a) FOOTING

AREA OF CONCRETE



$A_{①} = 17.5 ft^2$ (see earlier computation)

$A_{③} = 10 ft \times 10 ft = 100 ft^2$

$A_{②} = 17.5' \times 8' = 140 ft^2$

$A_T = 2A_{②} + 2A_{①} + A_3$

$A_T = 2(140) + 2(17.5) + \cancel{100}$

$A_T = 415 ft^2$

WEIGHT OF CONCRETE FOOTING

$.15 \ ^k/ft^2 \times 415 ft^2 = 62.25 \ ^{kips}/lin\ ft$

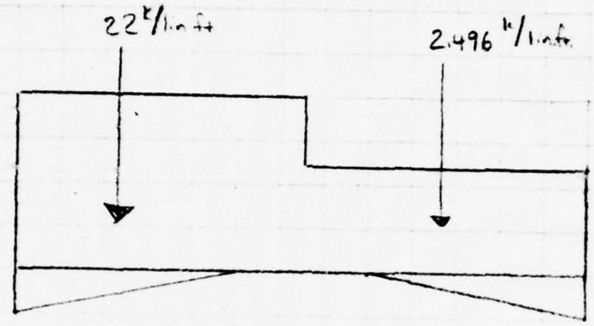
b) Wgt of GATE STRUCTURE $= 200^k$

$200^k / 45 ft. = 4.44 \ ^k/lin.ft$

DETERMINATION OF WEIGHT OF STRUCTURE

c) Wgt of water

SEE PREVIOUS CALCULATIONS



d) Wgt of Sheet Piling

Wgt = 2.23 kips/lin ft SEE PREVIOUS CALC.

e) Wgt of Deck and Railing

Wgt of Deck + Railing = 11 kips/ft SEE PREVIOUS CALC.

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BY LJB DATE 8-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A26 OF

CHKD. BY DATE DAM INSPECTION PROJECT C-222

SUBJECT COOPER RIVER TIDAL DAM - STABILITY ANALYSIS

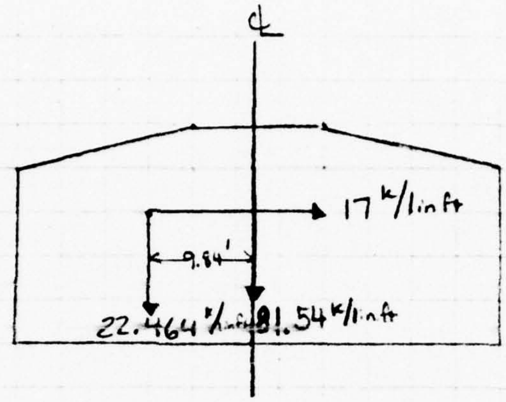
TOTAL VERTICAL FORCES

Concrete Foundation :	62.25 kips/lin ft.
Wgt of Water Upstream :	22 k/lin ft.
Wgt of WATER DOWNSTREAM:	2.49 k/lin ft.
Wgt of Sheet Piling	2.2 k/lin ft.
Wgt of Deck & Railing	11.0 k/lin ft.
Wgt of GATE Structure	4.4 k/lin ft.

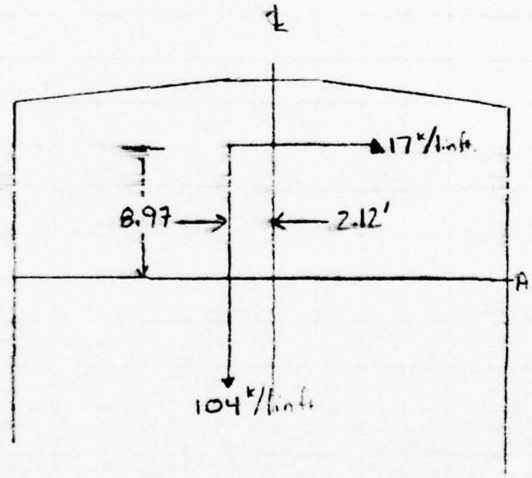
TOTAL = 104.0 k/lin.ft

BY LJB DATE 8-78 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A27 OF.
CHKD. BY DATE DAM INSPECTION PROJECT C-222
SUBJECT COOPER RIVER TIDAL DAM STABILITY ANALYSIS

DETERMINATION OF C.G OF VERTICAL FORCES



$$C.G.\ \text{VERTICAL} = \frac{22.464 \times 9.84}{104} = 2.12' \text{ from } ℄$$



FACTOR OF SAFETY AGAINST OVERTURNING = $\frac{RM}{OM}$

$$F.S. = \frac{104\,(24.62)}{17 \times 8.97} = 16.8$$

ECCENTRICITY OF RESULTANT FORCE

$$e = RM - OM / V$$

$$= 25605 - 152.5 / 104$$

$e = 23.1'$ from B or $.6'$ to the left of ℄

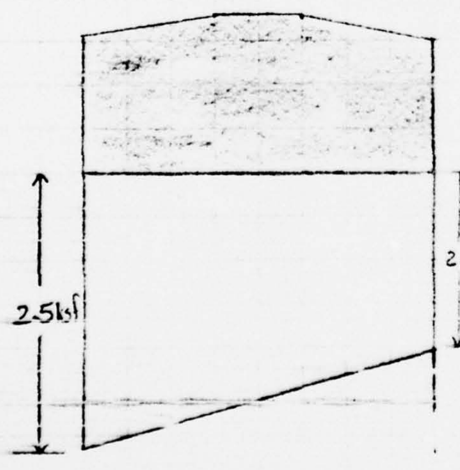
STRESSESS IN CONCRETE

$$\sigma_{max} = \frac{V}{b} + \frac{V6e}{b^2} = \frac{104}{45} + \frac{104(6)(.6)}{45^2}$$

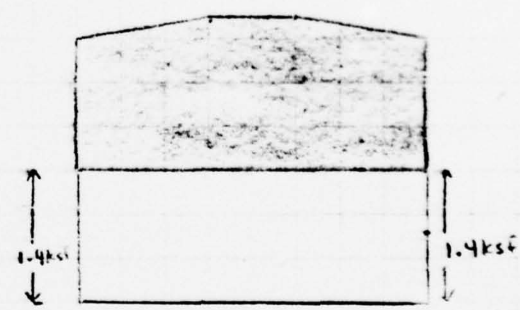
$$= 2.3 + .185 = 2.5 \text{ ksf}$$

$$\sigma_{min} = \frac{V}{b} - \frac{V6e}{b^2} = 2.3 - .185$$

$$= 2.1 \text{ ksf}$$



NO UPLIFT



UPLIFT

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******************************
HEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01
******************************
          COOPER RIVER PARKWAY DAM INSPECTION JOB#C222
          BY D.J.MULLIGAN
          FRIDAY SEPTEMBER 8TH 1978

                         JOB SPECIFICATION
     NG   NHR  NMIN  IDAY   IHR  IMIN METRC  IPLT  IPRT NSTAN
     50     1     0     0     0     0     0     0     0     0
                      JOPER   NWT
                          3     0

**********  **********  **********  **********  **********

                     SUB-AREA RUNOFF COMPUTATION

     INFLOW HYDROGRAPHS-   PMP & ONE HALF PMP
              ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                  2       0       0       0       2       0       1

                          HYDROGRAPH DATA
     IHYDG   IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
         0     -1   37.00     0.0   37.00     0.0   0.500       0       0       0

                            PRECIP DATA
                      NP   STORM     DAJ     DAK
                       6     0.0     0.0     0.0
                           PRECIP PATTERN
     0.0      0.38      1.03      7.39      2.90      1.50

                              LOSS DATA
     STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
       0.0     0.0    1.00     0.0     0.0    1.00     0.0     0.0     0.0     0.0

                      GIVEN UNIT GRAPH, NUHGQ=  24
      245.     1104.     2330.     3381.     3643.     3276.     2575.     1944.     1471.     1068.
      788.      561.      403.      298.      219.      154.      119.       84.       65.       47.
       38.       31.       25.       19.
             UNIT GRAPH TOTALS   23888. CFS OR 1.00 INCHES OVER THE AREA

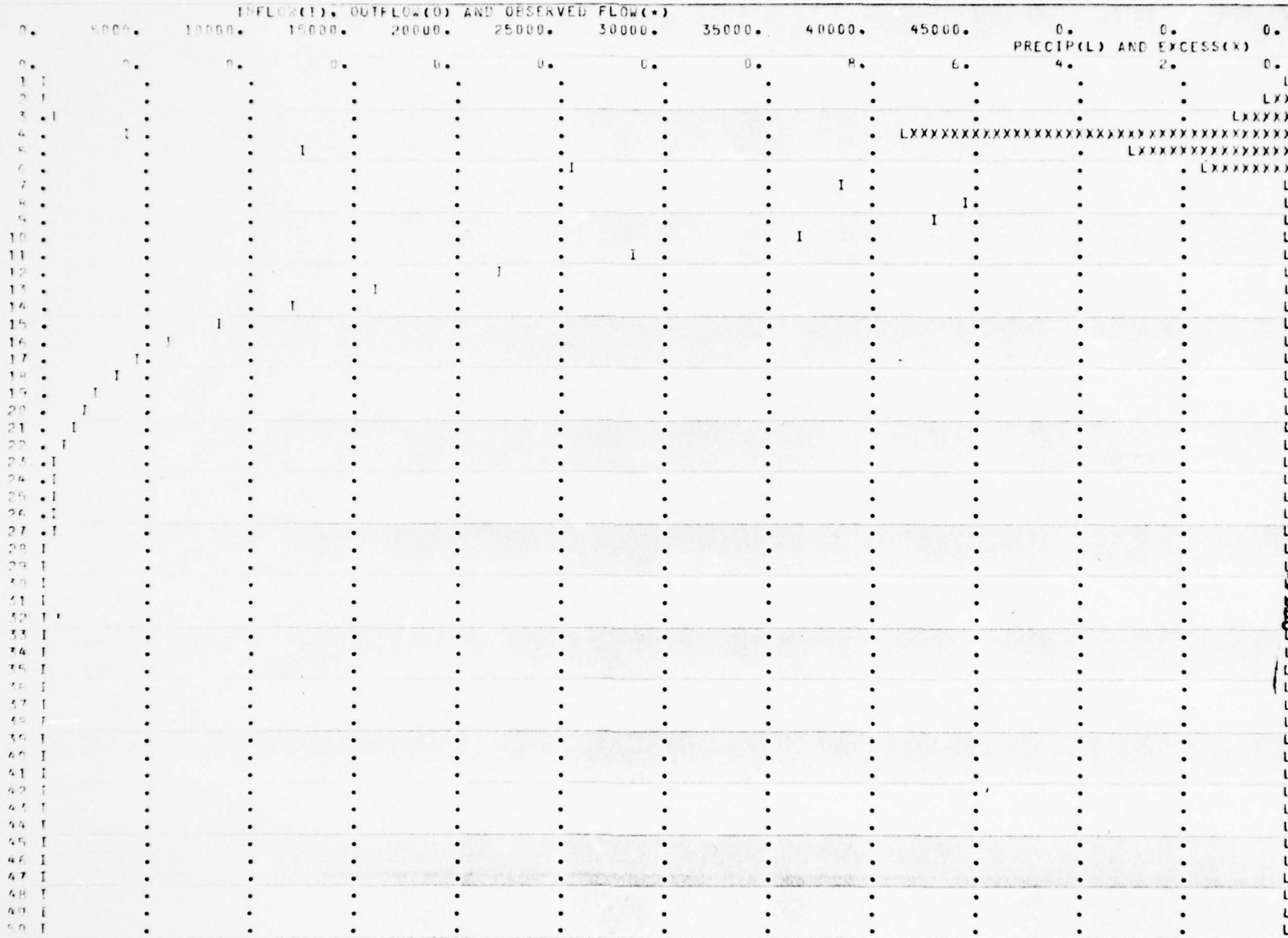
                            RECESSION DATA
            STRTQ=      0.0      QRCSN=      0.0      RTIOR= 1.00

                      END-OF-PERIOD FLOW
                  TIME   RAIN   EXCS    COMP Q
                     1    0.0    0.0        0.
                     2   0.38   0.38       93.
                     3   1.03   1.03      672.
                     4   7.39   7.39     3833.
                     5   2.90   2.90    12554.
                     6   1.50   1.50    25655.
                     7    0.0    0.0    38396.
                     8    0.0    0.0    44574.
                     9    0.0    0.0    43237.
                    10    0.0    0.0    36555.
```

11	0.0	0.0	28669.
12	0.0	0.0	21770.
13	0.0	0.0	16099.
14	0.0	0.0	11858.
15	0.0	0.0	8561.
16	0.0	0.0	6177.
17	0.0	0.0	4497.
18	0.0	0.0	3291.
19	0.0	0.0	2375.
20	0.0	0.0	1765.
21	0.0	0.0	1282.
22	0.0	0.0	965.
23	0.0	0.0	713.
24	0.0	0.0	556.
25	0.0	0.0	443.
26	0.0	0.0	351.
27	0.0	0.0	259.
28	0.0	0.0	93.
29	0.0	0.0	29.
30	0.0	0.0	0.
31	0.0	0.0	0.
32	0.0	0.0	0.
33	0.0	0.0	0.
34	0.0	0.0	0.
35	0.0	0.0	0.
36	0.0	0.0	0.
37	0.0	0.0	0.
38	0.0	0.0	0.
39	0.0	0.0	0.
40	0.0	0.0	0.
41	0.0	0.0	0.
42	0.0	0.0	0.
43	0.0	0.0	0.
44	0.0	0.0	0.
45	0.0	0.0	0.
46	0.0	0.0	0.
47	0.0	0.0	0.
48	0.0	0.0	0.
49	0.0	0.0	0.
50	0.0	0.0	0.
SUM	13.20	13.20	315323.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	44574.	36181.	13119.	6306.	315321.
INCHES		9.10	13.19	13.21	13.21
AC-FT		17950.	26034.	26073.	26073.

STATION 2



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RUNOFF MULTIPLIED BY 0.50

0.	47.	336.	1917.	6277.	12827.	19198.	22287.	21618.	18278.
14334.	[illegible]	8050.	5929.	4281.	3089.	2248.	1645.	1187.	883.
641.	463.	356.	278.	221.	176.	130.	46.	14.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	22287.	18090.	6559.	3153.	157660.
INCHES		4.55	6.60	6.61	6.61
AC-FT		8975.	13017.	13036.	13036.

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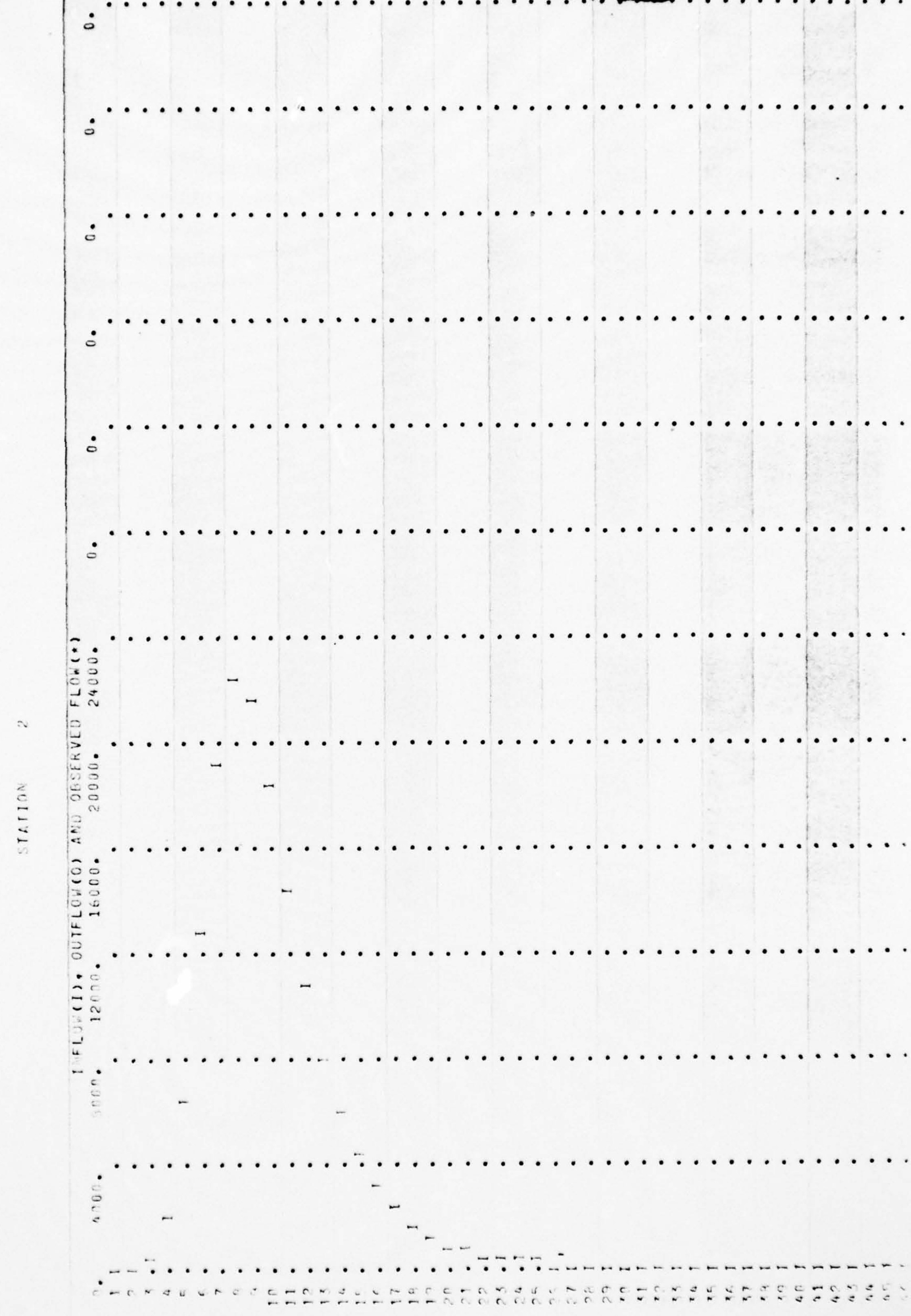

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HYDROGRAPH ROUTING

FLOOD ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
222	1	0	0	2	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	-1.

STORAGE=	0.	520.	1100.	1750.	2100.	2490.	2850.	3260.	0.	0.
OUTFLOW=	[illegible]	6100.	7200.	8300.	10970.	15544.	21041.	27900.	0.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	159.	0.	0.
2	2.	23.	3857.
3	-255.	191.	2745.
4	-369.	1126.	2254.
5	-240.	4097.	2813.
6	233.	9552.	4857.
7	1061.	16013.	7126.
8	2045.	20743.	10549.
9	2668.	21953.	18267.
10	2754.	19948.	19568.
11	2588.	16306.	17044.
12	2351.	12610.	13915.
13	2104.	9467.	11011.
14	1851.	6989.	9072.
15	1568.	5105.	7992.
16	1235.	3685.	7429.
17	869.	2668.	6763.
18	502.	1947.	6022.
19	179.	1416.	4625.
20	-73.	1035.	3536.
21	-267.	762.	2694.
22	-417.	562.	2047.
23	-531.	420.	1554.
24	-617.	317.	1179.
25	-683.	250.	897.
26	-731.	198.	685.
27	-769.	153.	523.
28	-799.	88.	391.
29	-825.	30.	282.
30	-844.	7.	198.
31	-858.	0.	138.
32	-868.	0.	96.
33	-874.	0.	67.
34	-879.	0.	47.
35	-882.	0.	33.
36	-885.	0.	23.
37	-886.	0.	16.
38	-887.	0.	11.
39	-888.	0.	8.

40	-889.	0.	5.
41	-889.	0.	4.
42	-889.	0.	3.
43	-889.	0.	2.
44	-889.	0.	1.
45	-890.	0.	1.
46	-890.	0.	1.
47	-890.	0.	0.
48	-890.	0.	0.
49	-890.	0.	0.
50	-890.	0.	0.
SUM			170350.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	19568.	15059.	6992.	3407.	170350.
INCHES		3.79	7.03	7.14	7.14
AC-FT		7471.	13876.	14086.	14086.

A35

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NATIONAL DAM SAFETY PROGRAM. COOPER RIVER PARKWAY (NJ 00393), D--ETC(U)
AUG 78 F K JOLLS DACW61-78-C-0124

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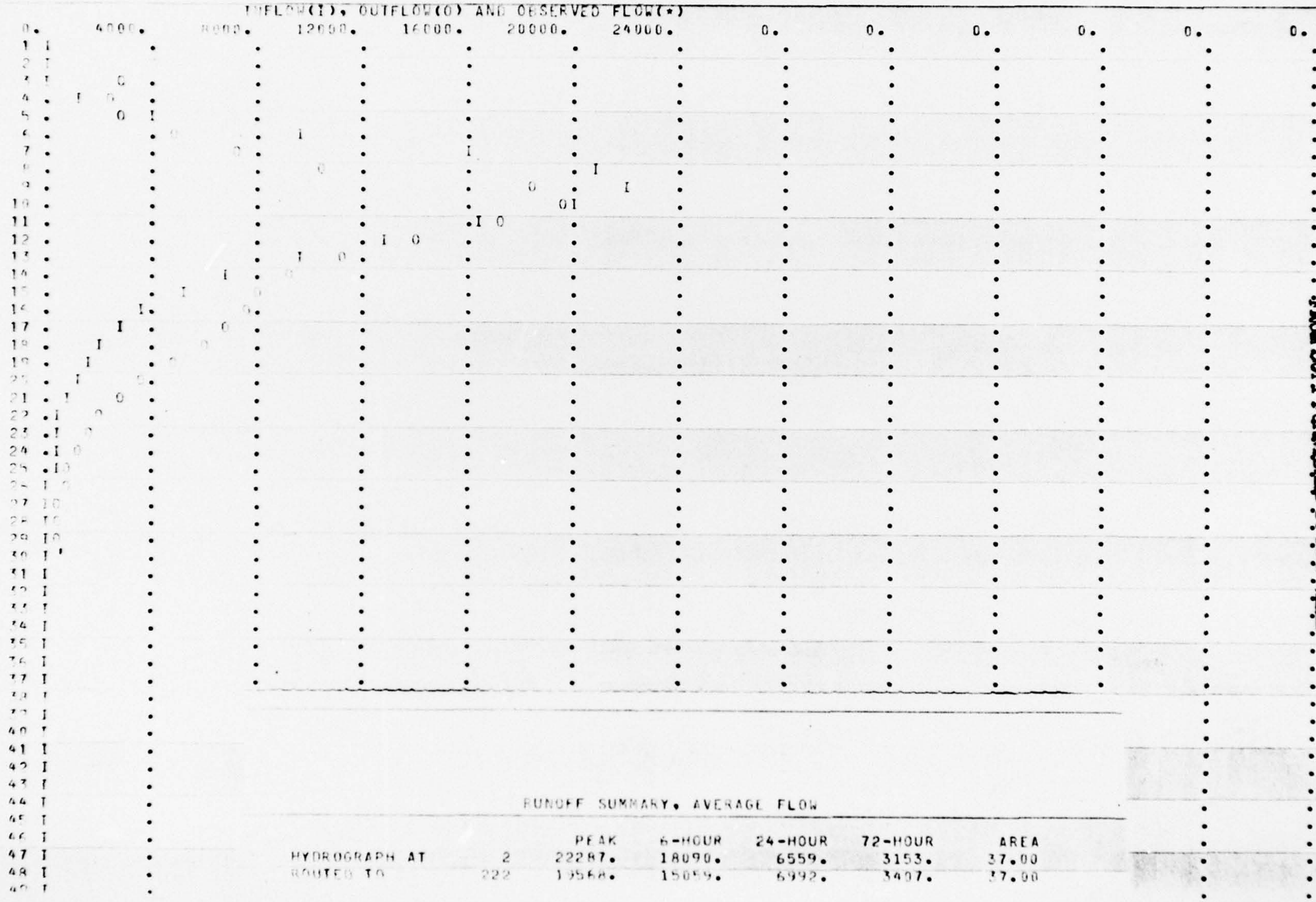
STATION 222

INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(*)



RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	2	22287.	18090.	6559.	3153.	37.00
ROUTED TO	222	19568.	15059.	6992.	3407.	37.00